

Residential ZNE Market Characterization

ATTACHMENT

Final Report

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1. DESCRIPTION OF ATTACHMENT

This document serves as an attachment to the main report of the Residential Zero Net Energy Market Characterization. In general, this attachment provides the full literature review, detailed results from the market actor interviews and surveys, and data collection instruments. The TRC team recommends that readers begin by reading the main report, and then review this attachment as needed.

Below, the TRC team describes what this attachment contains, compared to the contents of the main report:

- ◆ Literature Review – In this attachment, the TRC team presents the full Literature Review. The TRC team integrated key findings of the literature review into the relevant sections of the main report, to compare and contrast this study's findings.
- ◆ Detailed Data Collection Results – In this attachment, the TRC team presents the full results of the primary data collection efforts (i.e., results of the market actor surveys, interviews, and discussions). In the main report, the TRC team organized these findings by topic in Section 5 - Synthesis of Findings. The TRC team also summarizes the results by data collection effort in an appendix (Section 9) in the main report.
- ◆ Results of Energy Label Questions –The TRC team asked ZNE-type owners and energy efficient homes how their homes were described to them, in terms of energy performance or energy labels. However, the TRC team could not draw clear conclusions based on the data. Consequently, the team did not present this information in the main report, but rather presents the data in this attachment.
- ◆ Data Collection Instruments – The TRC team presents the interview, survey, and discussion guides used for this study.

2. LITERATURE REVIEW

The TRC team began the study by conducting a brief review of existing literature on ZNE-type homes as well as general literature on customer attitudes towards energy efficiency, PV, and valuation of these features. The literature review findings were useful in developing our primary data collection instrument, including survey, interview, and forum guides. In addition, the TRC team used the literature review findings to compare results collected through this study, and to fill in data gaps not collected through this study.

Within each topic area of the literature review, the TRC team organizes findings by topic. Because some studies include information on more than one topic area, some studies appear more than once. This report provides a list of each study, including its full name and link (if available) in Section 3.

In general, the TRC team provides findings as provided in the literature. The TRC team did not verify the accuracy of this information, and the inclusion of results in the literature review does not indicate the TRC team's endorsement of these results.

The TRC team focused on reviewing more recent findings, because many aspects of ZNE homes – e.g., costs, technologies, adoption patterns – are changing quickly. However, the TRC team did include some older findings if these were particularly relevant and had not been repeated more recently. Readers should review these older findings for qualitative, rather than quantitative information.

2.1. ZNE Home Characteristics

The TRC team reviewed common characteristics of ZNE-type homes observed in the published literature. This report presents results in two subsections: Performance Targets and ZNE Implementation.

2.1.1. ZNE Performance Targets

Several entities within California and the rest of the country have established criteria for ZNE homes. In general, they all incorporate two common elements – aggressive energy efficiency compared to current standard construction and building energy codes, and distributed generation (mostly PV).

The energy performance and PV targets for ZNE homes have shifted over time as more work is done on ZNE home specifications and lessons are learned from previous examples. Specifications have moved from “percent better than code” (SMUD 2004) to more nuanced metrics such as HERS criteria (CEC and CPUC 2013), TDV, and other performance metrics.

As early as December 2000, SMUD established the Zero Energy Home (ZEH) program that established targets for a ZEH house (SMUD 2004). These homes were intended to be typically 30-40% more efficient than the 2001 Title 24 code and have PV (as an optional upgrade offered to owners) to offset the remaining energy use. Some of the case studies from that effort are discussed showed that ZNE or at least near ZNE performance is possible for some homes (SMUD 2004).

SMUD has continued to develop the ZNE effort through several follow-up efforts; this included the subdivision Premier Gardens in 2004-2005 that is modeled to exceed 2001 Title 24 by approximately 30%, and that have 2 kW PV system standard on all homes (SMUD 2008). Treasure Homes in 2006-2007 are modeled to exceed 2005 Title 24 by approximately 40% better and include 2 kW PV system as a standard feature (SMUD 2008). Both Premier Gardens and Treasure Homes were monitored for post-occupancy savings, and were found to save approximately 58% on utility bills compared to a typical new construction home (SMUD 2008). The most recent iteration of SMUD ZNE Homes are the Home of the

Future¹, which targets 80% energy bill savings compared to code through a combination of energy efficiency and rooftop PV.

The Passive House movement has been gaining momentum over the past ten years in California and has established targets for total home energy use that could meet ZNE-ready definitions. Passive House California requires a home to use no more than 4.75 kBtu/sf/yr source energy in heating and cooling energy and no more than 38 kBtu/sf/yr in whole house source energy use for all end uses². It also requires a tight envelope with overall envelope leakage no more than 0.6 ACH50 (air changes per hour at 50 Pascals). Passive House does not have any requirements for distributed generation, but solar thermal can be used towards the achievement of the energy use target.

The ZNE Technical Feasibility Study conducted for the California IOUs established the technical feasibility of ZNE goals for California single-family homes based on energy simulations (Arup 2012). The study estimated the technical potential and identified approaches to achieve whole house energy use. As shown in Figure 1, a ZNE home in California has the potential to achieve substantial energy savings compared to 2013 Title 24, based on a TDV definition.

Title 24 2013 Comparisons		Climate Zones				
		15	12	10	3	16
Single Family Residential	T24 2013	26.78	19.31	17.66	15.64	21.34
	Exemplar	12.23	9.77	8.74	7.97	10.32
	% Difference	54%	49%	51%	49%	52%

Figure 1: Comparison of ZNE Exemplar Home to 2013 Title 24 Energy Use (Arup 2012)

At the national level, the Architecture 2030 Challenge (Architecture 2030) establishes a goal of carbon neutral buildings (using no fossil fuel GHG emitting energy to operate) by 2030. Within this challenge, there are minimum efficiency requirements of achieving 50% reduction in site energy consumption resulting in a net energy consumption of 19.2 kBtu/sf/yr. through efficiency measures. PV or other renewables take the building from 19.2 kBtu/sf/yr. to zero net energy.

The U.S. DOE recently rebranded the DOE Challenge Homes to DOE Zero Energy Ready Homes (DOE ZER). This voluntary effort builds on the requirements of Energy Star Homes version 3, along with lessons learned from the Building America practices. The DOE ZER homes are intended to be at least 40%-50% more efficient than standard practice/code and would earn a HERS score of low to mid 50's or less³. DOE ZER allows multiple pathways to meet the requirements: a prescriptive pathway based on specific envelope, HVAC, water heating measures and performance method alternatives based on energy modeling. There are national requirements and then state specific requirements for California and Washington. In California, the prescriptive requirements are to at least meet the 2013 Title 24 requirements for the building envelope, and exceed code requirements for HVAC and water heating.

¹ <https://www.smud.org/en/residential/environment/solarsmart-homes/home-of-the-future.htm>

² <http://passivehousecal.org/performance-criteria-certification>

³ <http://www.energy.gov/eere/buildings/guidelines-participating-doe-zero-energy-ready-home>

The performance pathway allows use of either the national HERS rating calculation or the CA HERS to demonstrate a compliance margin at least 25% higher than 2013 Title 24 (DOE 2013).

2.1.2. ZNE Implementation

While local, state and national agencies and organizations are busy formulating goals and targets for ZNE, progressive residential builders in California are not waiting for regulatory clarity. There are several major production builders in the state (e.g. KB Homes⁴, Shea Homes⁵), regional builders (e.g. DeYoung⁶) and custom homebuilders (e.g. One Sky Homes⁷) that are actively designing and building ZNE-type homes. Each builder is using a different approach to set the performance target and to explain or market the resulting home to consumers. Among the known ZNE examples that have received press coverage in recent years include the Cottle House, DeYoung ZNE Home, ABC Green Home⁸, UC Davis West Village⁹, SheaXero Homes, KB Homes Zero House 2.0, SMUD Home of the Future, SMUD Solar Smart Homes among others. All of these homes have incorporated various energy efficiency features such as increased insulation, high efficiency HVAC systems, high efficiency appliances and efficient water heating coupled with PV.

As an alternative approach, a newspaper article describes how a Shea Homes community in Palm Springs seeks to reach near or zero electricity primarily through 6 kW of PV (Desert Sun 2014). Based on the article, the design emphasizes PV; however, the homes do include some energy efficiency features, including energy efficient appliances (Desert Sun 2014). The builder targeted affluent baby boomers for these homes.

2.2. Meaning and Expectations of ZNE terms

2.2.1. ZNE Interpretations

2.2.1.1. TDV-Based Interpretations

The CEC has chosen to use a TDV-based definition for Title 24 purposes. The definition would also apply to programs run by the utilities that use code as the baseline. As described by the CEC (2013): “A ZNE Code Building is one where the net of the amount of energy produced by on-site renewable energy resources is equal to the value of the energy consumed annually by the building, at the level of a single ‘project’ seeking development entitlements and building code permits, measured using the California Energy Commission’s Time Dependent Valuation (TDV) metric.” These components are well-addressed in the time dependent valuation of energy concept used by the Energy Commission for its efficiency standards and the CPUC for its valuation of efficiency program savings.” Other studies have also recommended a TDV-based definition (e.g., McHugh 2011).

⁴ http://energy.gov/sites/prod/files/2013/11/f5/hiawinner_kbhomes_100213.pdf

⁵ <http://www.trilogylife.com/sheaxero/>

⁶ <http://www.deyoungproperties.com/why-choose-us/energysmart/net-zero>

⁷ <http://oneskyhomes.com/buildings/projects/projects-first-nze-home-ca>

⁸ <http://www.abcgreenhome.com/>

⁹ <http://westvillage.ucdavis.edu/>

2.2.1.2. Market Interpretations

Market actors including builders often use different definitions for ZNE. In addition, a given definition has different meanings for different stakeholders. Some market actors do not seem to distinguish between the terms ZNE, near ZNE, or ZNE-ready. Indeed, several homes are claimed to be ZNE when the same document lists the energy performance with PV offsetting 80% of the home energy (SMUD 2008b). Thus, deciphering what is truly ZNE, versus what is marketed as ZNE but does not meet strict ZNE definitions, is difficult.

A study by the Natural Resources Defense Council discussed interpreting ZNE at a broader level than site energy use (Goldstein 2012). This study discusses including transportation energy use related to the building location (i.e., the energy a building occupant must use to get to and from the building), water use (and the embodied energy of that water use), and material use and its embodied energy, into the definition of ZNE. The study indicated that a failure to include these additional energy consumption categories in the definition of ZNE could inadvertently shift building energy use into other sectors (Goldstein 2012).

2.2.2. Modeled versus Actual Energy Use in High Performance Homes

Most agencies and market actors define ZNE based on some type of modeled performance. However, actual energy performance is an important consideration. While little data exists that tracks actual energy use, this subsection presents findings that the TRC team found which addresses this topic.

SMUD and ConSol compared actual energy use for one year for homes in the Premier Gardens community, a “Zero Energy Home” development in the Sacramento area, with their modeled energy use (Keesee 2006). The study also compared the Premier Gardens’ homes actual energy use with the actual energy use of nearby code-built homes that were also new construction. The study found that the Premier Gardens homes used more energy than was predicted through modeling, but significantly less than the code-built homes.

Proctor Engineering Group (2014) compared actual energy use to projected energy use for four homes in California, and found that heating and cooling energy consumptions can vary for a single home by over 100%.

The DOE monitored a house in Sonoma, CA that was retrofitted to meet Passive House specifications, for actual energy use (DOE 2012a). The DOE found that the model (developed using BEopt) underestimated space cooling energy use by 44%, and overestimated space heating energy use by 24%, compared to actual energy use (DOE 2012a). In addition, the model assumed that the home met ASHRAE Standard 62.2 ventilation requirements, but the home’s ventilation system delivered 30% more fresh air than required by this standard. Overall, the study found that the largest discrepancies between modeled and actual energy use were in the cooling and ventilation energy loads.

For the Honda House, a ZNE home constructed in Davis, CA for research purposes, investigators will collect actual energy data, and compare it to modeled performance (Modera 2014). Since Honda and partners completed construction of this home in 2014, data are not currently available.

2.3. Market size

2.3.1. Current Market Size

According to a study of California ZNE buildings, “The falling costs of PV combined with advanced energy modeling capabilities that support integrated design processes, have expanded market awareness of ZNE and increased the pool of experts. In addition, changing social attitudes, public policies, and

incentive programs has increased the demand for highly energy efficient buildings” (Davis Energy Group 2012).

The Road to ZNE report documented several ZNE homes in California, but estimated the number of ZNE homes in California at less than 1% (HMG 2012).

The TRC team identified case studies of ZNE-type homes using the internet and suggestions from RFI contacts to estimate the number of ZNE homes. This report includes the findings as part of the market size estimates.

2.3.2. ZNE Market Potential

Estimates of market potential for ZNE homes varies significantly between technical potential studies, economic potential studies and estimates of industry stakeholders.

NREL (2006) conducted a potential impact study of zero energy homes (ZEH) in the U.S., and looked at different scenarios for adoption of ZEH on residential energy consumption. The study found that ZEH was technically feasible, but not economically feasible without financial incentives. The study found that energy consumption of single-family homes varied considerably, depending on the scenario followed. In general, the study found that, by 2050, ZEH with a tax incentive for solar technologies could reduce the energy consumption of all single-family homes by 19% while the stock of single-family homes increased by 39% (NREL 2006).

At a meeting of ZNE experts (Net Zero Energy Home Coalition 2012), attendees were asked their opinion on how much the total North American net zero energy home market (retrofits and new construction) will grow in the next 5 years. A majority of respondents (65%) said the growth will be about 5% per year, whereas only 6% of the respondents said that growth would exceed 10% per year.

2.4. Market Actors’ Drivers, Barriers, and Opportunities

2.4.1. Drivers

In general, residential customers’ motivations for buying ZNE homes is primarily for reduced operating costs, followed by other secondary reasons, including improved comfort, healthier homes, and environmental reasons.

ZNE Experts were asked their opinion on why consumers want net-zero energy homes (Net Zero Energy Home Coalition 2012). The highest responses (multiple responses allowed) were for reduced operating costs (90%), followed closely by reduced environmental footprint (75%). More than half of respondents also cited status symbol (56%) and healthier homes (54%). Durability (40%) and high tech features (25%) were less common responses. A U.K. survey found that most respondents found believed that energy bills would be the biggest benefit of having technological features fitted to their homes (NHBC Foundation 2012).

McHugh (2011) also reported that low or no utility bills, reduced environmental impact, and improved comfort are drivers. This study suggested that stable utility bills appeal especially to retired people. However, a survey of residential customers in the U.K. found that interest in paying a premium for “enhanced homes” decreases with age of respondent; the majority of those not interested cited ‘payback period’ as the main reason (NHBC Foundation 2012).

A Canadian study of a retrofit program found that participants indicated top priorities were improving comfort and lowering operating costs. Reduced environmental impact and improved indoor air quality

were lower priorities (CMHC 2007). This study also noted that, while energy efficiency retrofit are often cost effective (the energy savings outweigh the incremental increase in a mortgage payment), energy efficiency or solar retrofits still cannot compete with the “sexiness” of a major kitchen or luxury bathroom renovation.

The study by Dakin (2008) also reported on an informal dinner held in 2007 for owners that had purchased a home in a community of near ZNE homes. Most of the owners reported that energy efficiency and PV were not features they initially sought; location, based on jobs and schools, was the primary motivator. After choosing a floor plan, the energy efficiency and PV were a strong selling point. Most buyers reported that the efficiency and PV were good value, and that, if they were to purchase another home, they would select one with energy efficiency and PV features.

2.4.2. Barriers

The major barrier to most market actors, including builders and homebuyers, is cost.

HMG (2012) noted that a major barrier is cost, which in turn leads to a decreased demand by consumers. The U.K. study documented that very few owners assess the economic benefits of their investments (e.g., by monitoring energy bills or calculating payback times) (NBHC 2012).

The lack of consumer demand serves as a major barrier to builders. In addition, HMG (2012) noted that many ZNE projects require renewables (i.e. PV) to achieve their goals, and finding subcontractors who also have renewable systems experiences is limited. In addition, many contractors or trades may have to hire out to specialists for skilled labor in renewables or other advanced systems designs. The lack of skilled subcontractors was also noted by a Canadian study (CMHC 2007).

McHugh (2011) also noted challenges with net metering, including that, consumers are paid at the low energy tier rates, and there is not real-time rate for renewable energy exported to the grid. However, HMG (2012) noted that utilities must ensure that interconnection policies meet safety and reliability standards, and that increased integration costs are recognized and appropriately recovered.

A study by the U.S. DOE (2011) found that the heavy focus on air sealing without designed ventilation provisions could negatively affect health, safety, and durability. In addition, the U.K. study found that consumers were averse to certain terms; for example, fewer than half of respondents thought that “airtight” was a positive attribute for a home. However, when it was described as “resulting in a home with no leaks or draughts, preventing heat escaping and keeping costs down”, the number of positive responses almost doubled. Similarly, the term “greywater recycling” was perceived negatively among the forums; but when a different description was provided (“waste water re-use”), consumers had a more positive response (NBHC 2012).

2.4.3. Opportunities

Several studies identified opportunities for reducing barriers to ZNE, and the TRC team compiles these opportunities here.

The U.S. DOE (2011) identified the following opportunities for achieving high levels of energy savings:

- ◆ “Concentrate on energy efficiency measures that are associated with other benefits that the owner desires (enhanced comfort, improved IAQ, dust control, durability, etc.).
- ◆ Use empirical data from the field to assess and track the accuracy of reference software.

- ◆ Use a rigorous process to identify potential issues in building energy simulation tools using comparisons of predicted versus metered energy use and savings.
- ◆ Perform careful field data collection, HVAC model development, and computer simulation validation from multiple test sites and climates surrounded by whole-house performance measurements to generate well-characterized datasets.
- ◆ Conduct research to determine the health, safety, and durability of high-R enclosures, focusing on their moisture performance.
- ◆ Develop, evaluate, and deploy smart and robust ventilation and ventilation control technologies.
- ◆ Develop on-demand ventilation solutions that can sense the presence of occupants and the operation of unvented gas appliances, electric and gas dryers, and bath and kitchen exhaust fans.
- ◆ Participate in committees defining standards for interoperability of MELs communication and control.”

NREL (2006) called for research and development to reduce the cost of ZEH and to facilitate market transformation. Activities could include outreach to consumers, builders, real estate agents, appraisers, and utilities; technical training; policy development; and R&D on the integration of ZEH technologies.

Several studies provided recommendations for overcoming cost barriers. Dakin (2008) suggested including efficiency features and PV as standard feature in all homes in a community (instead of presenting them as optional features). In this approach, installed costs are lower due to volume and standard bidding of features, and it is easier for sales staff to sell the features if they are standard components. The California-based study by HMG and a Canadian study (CMHC 2007) both note the importance of incentives for reducing the cost barrier. The U.S. DOE describes how the SAVE (Sensible Accounting to Value Energy) Act, developed by the Institute for Market Transformation (IMT), is a new proposal that seeks to correct mortgage underwriting and home appraisal practices to assess the expected energy costs for mortgage loan applicants (DOE 2012c).

2.5. Early Adopters of ZNE-type Homes and Energy Efficiency

A study of households in California assessed general awareness, knowledge, and attitudes regarding energy efficiency (RIA 2012). This study categorized the residential market into five segments. The two groups most likely to install energy efficiency upgrades were:

- ◆ Leading Achievers (27% of the market), were highly educated and older owners with the highest incomes. They were more likely to install various low- to medium-cost energy efficiency measures or conduct a comprehensive home energy upgrade. They had high awareness/knowledge of, concern about, and responsibility toward the effects of their energy use on the environment.
- ◆ The second group, Practical Spenders (22% of the market), were similar to Leading Achievers in that they were older owners with high incomes who were more likely to install various low- to medium-cost energy efficiency measures. They were distinguished from Leading Achievers by their moderate levels of education and relatively low levels of awareness, knowledge, or concern about the effects of their energy use on the environment.

An article about a builder that seeks to build near zero electricity homes notes that the builder (Shea Homes) is targeting affluent baby boomers for the community (Desert Sun 2014).

2.6. Cost and Value of ZNE

This section describes the cost of achieving ZNE, perceived value of ZNE to the market, and financing opportunities for ZNE homes.

2.6.1. Incremental Cost for ZNE

According to a 2012 California study, conventional efficiency upgrades to a code-compliant new home (e.g. improved windows and insulation levels; high efficiency space conditioning, water heating, and lighting systems) to achieve about 40% reductions in home thermal and lighting energy consumption will cost roughly \$2 - \$8 per square foot of conditioned floor area. More advanced design approaches, passive strategies, and emerging technologies, currently may cost three to four times more. "At this point, it is not clear whether these advanced approaches will mature to the point where they are competitive with falling PV costs (currently at about \$8 to \$10 per square foot of conditioned floor area in typical applications)" (Davis Energy Group 2012).

BIRAenergy conducted cost analysis of the De Young ZNE home, and estimated the incremental cost for the efficiency upgrades as \$13,093, with an additional \$5,500 for a fully pre-paid lease for a 6 kW PV system (BIRAenergy 2013).

Dakin (2008) estimated the incremental cost to the owner for purchasing a home with PV and efficiency as an option in the range of \$15,000 to \$20,000 (Dakin 2008), of which the bulk of the incremental cost is for the PV. The authors note that, even though the option can be shown to pay for itself, buyers are reluctant to add this cost to their house, in part because this option competes with other amenities (e.g., granite countertops, hardwood floors) that have a better perceived added value.

Coldham (2008) discusses how (in the Northeast climate) a very thermally efficient envelope can eliminate the need for heating ducts and associated fans, thereby making the cost of a highly efficient home roughly cost neutral. To achieve this goal, Coldham (2008) describes a total commitment to this cost shifting that favors enhancing building envelopes at the expense of conventional central heating systems.

2.6.2. Appraised Value

Several studies have documented that energy efficient and high performing homes sell for more, and/or may sell faster than code-built homes.

Kok (2012) analyzed the sales price of 4,321 homes in California from 2007 to 2012 that were certified under green labels (ENERGY STAR Homes, GreenPoint Rated, or LEED for Homes), of which 70% were new construction, and compared them to the 1.6 million homes sold between 2007 and 2012. The econometric approach used, called hedonic pricing analysis, controlled for variables that affect real estate pricing, such as vintage, size, location, and the presence of major amenities (e.g., swimming pools). It was the first study to provide statistical evidence that, holding other factors constant, a green label on a single-family home in California sell for more (9% with a standard error of $\pm 4\%$) compared to a similar home without the label. Based on an average sales price of a non-labeled home in California is \$400,000, the price premium for a certified green home translates into some \$34,800 more than the value of a comparable home nearby. Note that this study did not prove that the labels themselves increased the value. These were high performing homes, and these features, different marketing approaches, or other differences may have led to the sales increase. This study also found:

- ◆ The results show that the resale premium associated with a green label varies considerably from region to region in California, and is highest in the areas with hotter climates. It is plausible that residents in these areas value green labels more due to the increased cost of cooling a home.

- ◆ The sales premium is positively correlated to the environmental ideology of the area, as measured by the rate of hybrid vehicle registrations. This suggests that some owners may attribute value to intangible qualities associated with owning a green home, such as pride or their perceived status.

A California study by Davis Energy Group also found that high performance homes sold faster (new homes) or for higher values (at resale). It noted an increase in sales for LEED certified homes in a Rocklin, CA development, and found that, during 2005 to 2007, the sales rate of these homes was 2.2 times that of a competing neighboring subdivision. The reduced carrying costs due to faster sales generated cost savings that were nearly five times greater than the incremental construction cost. Anecdotally, the resale of seven homes in 2012 in the Carsten Crossings subdivision and homes in neighboring comparable subdivisions (fourteen homes) suggest a 12% higher per square foot market valuation for the Carsten Crossing homes (Davis Energy Group 2012).

DOE (2012c) noted several barriers to including energy efficiency in appraisals. The main barrier is the lack of comparable sales and market data. With limited data, appraisers have resorted to assessing arbitrary values for energy efficiency improvements. To successfully implement accurate valuations of residential energy efficient improvements, DOE (2012c) recommended that appraisers must be provided with adequate resources, including market data, standardized assessment methods, and education.

2.6.3. Consumer Willingness-to-pay

ZNE Experts¹⁰ in the Net Zero Energy Home Coalition (2012) were asked their opinion on how much more consumers are willing to pay for a net zero energy home (including both new construction and retrofits) in North America. (Attendees were primarily from the U.S. and Canada). Most respondents reported either between \$10,000 and \$25,000 (40%) or between \$25,000 and \$50,000 (37%), although 19% reported below \$10,000.

Dakin (2008) has found that ZNE homes can reduce annual energy bills by 50-70% compared to homes built to California's Title 24 code, and that this bill reduction is greater than the increase in the mortgage for building a home to a ZNE standard. (In other words, if the buyer shoulders the incremental cost to build a ZNE home, the energy bill savings outweigh the mortgage increase, making it cost effective for the homebuyer.) However, an NREL study found that energy features were a low priority in buyers' final purchase decisions (Dakin 2008).

2.6.4. Financing ZNE

The TRC team included a brief review of financing energy efficiency in the residential market. Most literature discussed financing of existing homes (retrofits), but many of the findings apply to new construction as well.

A web article in 2014 noted that energy efficiency mortgages are, thus far, better in theory than practice. Total energy efficiency mortgage loans per year have fallen in the U.S., from 2,496 in 2010 to 601 in 2013 (Golden 2014). According to the author, one reason is that energy efficiency mortgages (for upgrades to existing homes) add only a small amount to the base mortgage, making them not worth the time for brokers and realtors. Another reason is that home purchases are already complex and stressful, so adding another process (which may require additional inspections or verifications) is not a priority (Golden 2014).

¹⁰ The experts surveyed included a mix of service providers, industry staff, builders, government staff, and others. For more details, see the link for Net Zero Energy Home Coalition (2012) under Bibliography.

Similarly, Fuller (2009) found that residential financing programs are reaching a small fraction of potential customers. “Despite the 150+ loan programs for residential energy efficiency in the United States, only a tiny fraction of the population has been reached. Most of the programs reached less than 0.1% of their ‘potential’ customers in 2007.” The study noted that programs that have higher participation rates tend to have networks of engaged and informed contractors who use the financing program as a sales tool (Fuller 2009).

An ACEEE study found that the lack of customer demand is by far the greatest obstacle to increasing the use of energy efficiency financing (ACEEE 2014). Lenders are hesitant to participate in the energy efficiency market, because they are unconvinced that there is sufficient demand to justify their investment (ACEEE 2014). In addition, most of the uptake in energy efficiency financing for residential buildings has been for retrofits (ACEEE 2011). For example, an ACEEE study of energy efficiency programs found that the SMUD Residential Loan Program had one of the highest participation rates in the U.S., and that one of the keys of this program’s success is its simple model and streamlined implementation (ACEEE 2011). However, this program is for retrofits (not new construction) and typically used for equipment replacement.

CPUC (2011) found that the single-family residential sector is not restricted by lack of financial products. However, the study found that “it is restricted by (1) high interest rates associated with that financing and (2) the fact that many of the financing products now available are cumbersome and difficult to access. In addition, California’s residential financing sector is hampered by a lack of project volume, particularly for comprehensive whole house energy efficiency projects.”

As described by a study of financing programs by the DOE (2012c), current underwriting methods were predominantly developed in the 1940s and have not evolved much since then. At that time, energy costs were relatively low and steady, and most houses were similarly constructed without investments in energy efficiency. Underwriting is generally an assessment of three factors: 1) The borrower’s credit, 2) An assessment of the property value, 3. an assessment of the borrower’s ability to make the mortgage payments on time. Thus, current underwriting and home appraisals do not include some costs of ownership, including energy costs. However, energy costs have risen steeply since the 1940s, and are expected to continue rising. According to the Institute for Market Transformation, average home energy costs in the U.S. are \$2,278 for energy, exceeding the costs for property tax (\$1,879) and insurance (\$791) (U.S. DOE 2012c).

2.6.5. Impacts of PV

2.6.5.1. Costs of PV

An LBNL study tracked the precipitous decline of PV system costs in the U.S. from 1998 to 2012. For projects installed in 2012, median installed prices were \$5.3/W for systems ≤ 10 kW (LBNL 2013a). The study notes that the recent decline in installed system prices is largely attributable to falling module prices. The study also found that installed prices vary widely across states. Among ≤ 10 kW systems completed in 2012, for example, median installed prices range from a low of \$3.9/W in Texas to a high of \$5.9/W in Wisconsin, potentially reflecting differences in market size, permitting requirements, competitiveness of the installer market, labor rates, sales tax exemptions, and incentive levels. Finally, LBNL (2013a) noted that the residential new construction market offers potential price advantages relative to residential retrofits. In particular, over the 2008 to 2012 period, the median installed price of rack-mounted systems in new construction was \$0.2/W to \$1.1/W lower than for comparably sized retrofit systems, when focusing on systems 2-4 kW in size.

2.6.5.2. Sales Impacts of PV

In general, studies have found that PV leads to an increase in the sales price of homes in California, although there are challenges with valuing PV in appraisals.

LBNL conducted a study of premiums for California homes with PV, and found they are strongly correlated with PV system size and weakly correlated with PV system age. The study authors estimated that each 1-kW increase in size equates to a \$5,911 higher Premium (p -value 0.000) and each year systems age equates to a \$2,411 lower premium (p -value 0.087) (LBNL 2013b).

LBNL conducted another study of homes sold in California from 2000 through 2009, and found that the sales price increase ranged from \$4.9 to \$6.4 per installed watt of PV. This increase was typically around \$5.5 per watt, which corresponds to a sales increase of approximately \$17,000 for a new 3.1 kW system, the average sized system installed in the homes studied (LBNL 2011). The TRC team notes that this increase in sales price was at the higher end of the range of the costs of PV reported in LBNL (2013), although these studies were done over different timeframes. LBNL (2011) also found that the value of PV was typically higher for existing homes than for new homes. The authors theorized that one possible reason for this disparity is that some builders of new homes may include PV as a standard feature, to differentiate themselves, and that these builders may be willing to accept a lower premium in return for a faster sales time (LBNL 2011).

Similarly, ConSol (2008) found that homes with PV sold for a premium compared to non-PV homes. As one example, PV homes in one development had a 2.3% premium compared to non-PV homes at the time of original sale. This premium increased to 4.1% for these homes at resale (ConSol 2008).

Based on a Colorado study (Colorado Energy Office 2013), the overwhelming majority of realtors surveyed believe that owned PV increase the market value and marketability of homes. This study reports that the economic life expectancy of PV is currently 25 years, and even at 25 years, it is expected to operate at 80% productivity. Based on the study's review of 30 case studies, marketing times were notably lower for homes with PV, and 22 of 30 case studies found that PV contributed \$1400 to \$2600 per kW to market value. The Colorado study found that appraisers used three different methods for valuing homes with PV:

1. The sales comparison approach was often applicable. The sales comparison approach was applied whenever paired sales were located. Evidence indicates buyers look to other sales of homes with PV systems to understand the value of PV systems: therefore, sales of properties with PV systems were relevant to this study.
2. The cost approach was most often applicable. One of the best sources of cost data was from permit information. Cost data are typically available from installers, permit data and cost services. Cost was a consideration for participants in this market area and thus, cost data was relevant.
3. The income approach was also usually applicable. However, not all of the data needed to develop the income approach was always available. Income was a very important consideration for market area participants and thus, income data was relevant. The study noted that the PV Value tool offers a much more sophisticated analysis that requires considerable study and understanding for an appraiser to interpret its indicator of market value.

While the studies above have documented an increase in sales price from PV in some instances, Klise (2013) describes the valuation challenges for PV, including that paired sales data are often unavailable,

and that cost data may not be reliable. In these instances, Klise (2013) advocates for the use of an income-based valuation method to capture the value of a PV system.

2.6.5.3. Residential Third Party PV

Based on a Third-Party Ownership Market Impact Study for the CPUC, third party arrangements for PV have dramatically increased in California since 2009 (Navigant 2014a). In 2012, almost three-quarters of all residential PV capacity installed through the California Solar Initiative (CSI) was third-party owned. Since the middle of 2010, residential customers have entered into PV leases and Power Purchase Agreements (PPAs) at about the same rate, indicating that customers do not generally prefer one to the other. In general, the study found that most residential customers were satisfied with their third party PV arrangement and benefitted financially from the arrangement. Navigant (2014a) also found that the residential PV industry is expecting the ramp down of CSI rebates, so this should not affect the industry dramatically. However, there is confusion in the market concerning potential changes to net metering and retail rate restructuring due to AB 327 (Navigant 2014a). The study authors recommend educational materials to help customers understand the potential effects of rate reform and changes to net metering.

Another study conducted by Navigant by the CPUC investigating PV noted the damage that PV can cause to roofing materials (Navigant 2014c). The study notes that many PV industry market actors have taken steps to minimize the potential risks of installing PV on residential roofs, by accounting for these risks in contracts, pricing, and installation decisions. However, damage sometimes occurs and many third party owned systems puts the responsibility for replacing PV systems on the host customer (e.g., the owner). Owners may also need to pay for the cost of reinstallation during a re-roofing event, even if the PV is third party owned. Navigant (2014b) notes that these roofing issues could create business risk for PV companies or to the industry as a whole.

A study in Massachusetts compared the local economic impacts of two ownership and financing scenarios (Cadmus 2013). In the first, the PV system is owned by the owner and financed through a bank. In the second, the PV system lease (or power purchase) agreement is through a third party. The study concluded that direct ownership results in a substantially higher economic benefit for both the local economy and the owner (Cadmus 2013).

2.7. Plans and Policies Encouraging ZNE-type Homes

In its Long-Term Energy Efficiency Strategic Plan, the CPUC set a goal for all new residential construction to be ZNE by 2020 (CPUC 2008).

In an updated document, the CEC and CPUC provided an Action Plan Vision Framework, which provided goals towards achieving this ZNE target (CEC and CPUC 2013). These goals included:

- ◆ To create awareness of the value and benefits of ZNE and build demand
- ◆ Increase participation and improve the quality of ZNE education and training
- ◆ Ensure availability, effectiveness, and efficiency of technical tools
- ◆ Quantify value of ZNE, support robust financing, and ensure affordability
- ◆ Drive future grid infrastructure and technological improvements
- ◆ Align regulations, policies, incentives, and codes

In addition to these statewide plans and frameworks, various local governments have adopted Reach Codes or other ordinances or initiatives to promote energy efficiency and/or distributed generation. For

example, the cities of Sebastopol, Lancaster, and Davis have initiatives that require PV on all new residential construction (City of Sebastopol 2013, City of Lancaster 2013, and Cool Davis 2014). In the case of Davis, the requirement provides a tiered approach, with smaller homes required to install a smaller PV system (Cool Davis 2014). The ordinance also reflects the goals of the City’s Climate Action Plan (Cool Davis 2014).

3. APPENDIX B: BIBLIOGRAPHY

Below are the studies and other resources included in this report, including those in the full literature review presented in Section 2 of the report Attachment. Where possible, the TRC team provides links to these studies and resources.

This bibliography includes reports, articles, and presentations. For information obtained from websites, this report uses a footnote for the citation.

ACEEE 2011: What Have We Learned From Energy Efficiency Financing Programs?

Primary Author: Sara Hayes (ACEEE) et al.

Publication Date: September 2011

Publication Type: Report

Link: <http://www.aceee.org/research-report/u115>

ACEEE 2014: Engaging Small to Mid-Size Lenders in the Market for Energy Efficiency Investment: Lessons Learned from the ACEEE Small Lender Energy Efficiency Convening (SLEEC)

Primary Author: Casey Bell (ACEEE) et al.

Client: NREL, Argonne National Laboratory, and DOE

Publication Date: 2014

Publication Type: Report

Link: <http://www.aceee.org/research-report/f1401>

Architecture 2030 (2010): 2030 CHALLENGE Targets: U.S. Residential Regional Averages

Primary Author: Architecture 2030

Publication Date: 2006-2010

Publication Type: Survey Analysis

Link: http://www.architecture2030.org/files/2030_Challenge_Targets_Res_Regional.pdf

Arup 2012: The Technical Feasibility of Zero Net Energy Buildings in California

Primary Author: Arup

Client: PG&E

Publication Date: 2012

Publication Type: Energy Simulation Analysis

Link:

http://www.energydataweb.com/cpucFiles/pdaDocs/904/California_ZNE_Technical_Feasibility_Report_Final.pdf

Bell 2014: Engaging Small to Mid-Size Lenders in the Market for Energy Efficiency Investment: Lessons Learned from the ACEEE Small Lender Energy Efficiency Convening (SLEEC)

Primary Author: Casey J. Bell and Virginia Hewitt (ACEEE); Angela Ferrante (Energi, Inc.)

Publication Date: February 2014

Publication Type: Conference paper

Link: <http://aceee.org/research-report/f1401>

BIRAenergy 2013: PG&E ZNE Pilot Program: De Young Zero Net Energy Home

Primary Author: Rob Hammon (BIRAenergy)

Client: PG&E
Publication Date: December 2013
Publication Type: Final Report

Cadmus 2013: Comparative Regional Economic Impacts of Solar Ownership/Financing Alternatives
Primary Author: Cadmus, Meister Consultants Group, and Sustainable Energy Advantage
Client: Massachusetts Department of Energy Resources
Publication Date: September 30, 2013
Publication Type: Report

CEC 2007: 2007 Integrated Energy Policy Report
Primary Author: CEC
Publication type: Report
Link: www.energy.ca.gov/2007_energypolicy/

CEC 2013: Integrated Energy Policy Report 2013 IEPR
Primary Author: CEC
Publication type: Report
Link: <http://www.energy.ca.gov/2013publications/CEC-100-2013-001/CEC-100-2013-001-CMF.pdf>

CEC and CPUC, 2013: New Residential Zero Net Energy Action Plan
Primary Author: CEC, CPUC
Publication Date: October 14, 2013
Publication Type: Action Plan
Link: http://www.cpuc.ca.gov/NR/rdonlyres/D8EBFEE4-76A5-47AC-A8F3-6E0DAB3A9E5D/0/DRAFTZNE_Action_Plan_Comment.pdf

CMHC 2007: Approaching Net Zero Energy in Existing Housing
Primary Author: Abri Sustainable Design & Consulting
Client: Canada Mortgage and Housing Corporation (CMHC)
Publication Date: December 17, 2007
Publication Type: Report
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Christie 2014: Moving beyond 'Better than Code': New Market Transforming Zero Net Energy Aligned Residential New Construction Programs
Authors: Matthew Christie (TRC), Conrad Asper (PG&E), John Morton (SCE), Chuck Berry (SDG&E), and Darrell Brand (SoCalGas)
Publication Date: 2014
Publication Type: Conference paper
Link: <http://aceee.org/files/proceedings/2014/data/papers/2-1265.pdf>

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Primary Author: City of Lancaster
Publication Date: 2013

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Primary Author: City of Sebastopol

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Primary Author: Bruce Coldham

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Primary Author: Colorado Energy Office

Client: NA

Publication Date: May 2013

Publication Type: Report

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Primary Author: Rob Hammon

Publication Date: 2008

Publication Type: Presentation

Cool Davis 2014: Council Approves Davis's PV Ordinance for New Single-family Home Construction

Primary Author: Alan Pryor (Cool Davis)

Publication Date: August 26, 2014

Publication Type: Article

Link: <http://www.cooldavis.org/2014/08/26/be-present-on-aug-26th-as-council-considers-daviss-pv-ordinance-for-new-single-family-home-construction/>

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Publication Date: September 2008

Publication Type: Report

Link: <http://www.cpuc.ca.gov/NR/rdonlyres/D4321448-208C-48F9-9F62-1BBB14A8D717/0/EEStrategicPlan.pdf>

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Primary Author: Harcourt Brown & Carey, Inc.

Client: CPUC

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Primary Author: William Dakin (Davis Energy Group), David Springer (Davis Energy Group), and Bill Kelly (SunPower Corporation)
Publication Date: 2008
Publication Type: Conference paper
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Primary Author: Davis Energy Group
Client: PG&E
Publication Date: December 19, 2012
Publication Type: Report
Link: <http://www.cpuc.ca.gov/NR/rdonlyres/2CDD0FB7-E871-47C0-97D0-A511F5683B57/0/PGECAZNECostStudy.pdf>

Desert Sun 2014: Builder plans homes targeting 'net-zero' electric bills in Indio, Palm Springs
Primary Author: Dominique Fong (The Desert Sun)
Publication Date: February 2014
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DOE 2008: Zero Energy Buildings Database
Primary Author: U.S. Department of Energy (DOE)
Publication Date: Last updated June 2008
Publication Type: On-line building database
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Primary Author: DOE
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Link: http://energy.gov/sites/prod/files/2013/11/f5/ba_tech_roadmap_0.pdf

DOE 2012a: Sonoma House: Monitoring of the First U.S. Passive House Retrofit
Primary Author: Alliance for Residential Building Innovation (ARBI)
Client: DOE Building Technologies Program
Publication Date: December 2012
Publication Type: Report
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DOE 2012b: Long-Term Results: New Construction Occupied Test House, Urbana, Illinois
Primary Author: Stecher and Allison, IBACOS, Inc.
Client: DOE
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Primary Author: Energy and Environmental Economics, Inc. (E3)

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Client: DOE

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Primary Author: Mark Modera (Western Cooling Efficiency Center) and Michael Koenig (Honda)

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Primary Author: Sam Rashkin (DOE)

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4. DETAILED DATA COLLECTION RESULTS

This section includes detailed results from data collection activities. In Section 9 of the main report, the TRC team presents summarized versions of each data collection effort.

4.1. High Performance Builder Interviews

This section provides findings from in-depth interviews with 16 residential new construction production and/or custom builders in California and three building industry experts. The 16 builders are industry leaders who regularly build homes that exceed Title 24, including at least some ZNE-type homes.

The following two primary research objectives guided the analysis of builder interviews:

- ◆ Characterize residential ZNE and near ZNE new construction market
- ◆ Assess drivers, barriers, and opportunities to messaging, building, financing, and purchasing of ZNE-type new construction homes

For each objective, the TRC team explored if and how responses differed between custom and production builders as well as among builders who primarily build in Northern California, Southern California, or statewide. The description below identifies noteworthy differences between builders' responses by type and location of home.

4.1.1. Builders Sample Description

The TRC team developed a list of builders using three different sources: input from the California Advanced Homes Program (CAHP) managers, responses to a Request for Information (RFI) survey, and publicly available case studies of ZNE-type projects. Targeted builders included those assumed to represent the leading edge of energy efficient homebuilding in California, based on their homes delivered through the CAHP program, association with a ZNE case study, or based on ZNE practitioners' responses through the RFI survey. Ultimately, the TRC team identified 25 builder contacts that represented the population of California high performance homebuilders in California, and completed interviews with 16. The team conducted interviews between April 24 and June 3, 2014. Interviews lasted between twenty to sixty minutes, depending on the length of each builder's response.

The sample included 9 custom builders and 16 production builders. The team sought to complete interviews with more production builders, because they provide a greater market share of the residential new construction in California. However, in general, custom builders were more willing to agree to an interview than production builders were. Half of the interviewed builders (8 of 16) were production builders. The remaining builders were either custom builders (7 of 16) or build both production and custom homes (1 of 16). These builders constructed homes throughout California, with the majority (9 of 16) building primarily in Northern California. The table below summarizes the types of builders interviewed.

California Region	Builder Type			Total
	Custom	Production	Custom and Production	
Northern	6	2	1	9
Southern	1	3	0	4
Statewide	0	3	0	3
Total	7	8	1	16

Figure 2. Description of Builders Interviewed

The TRC team also interviewed three building industry experts to understand the broader perspective on the homebuilding market in California, including motivations and challenges for building ZNE-type homes. Experts included representatives from BIRAenergy¹¹, the California Building Industry Association (CBIA)¹², and ConSol¹³.

4.1.2. ZNE-type Homebuilding Practices

Builders reported using a number of different guidelines for building homes above code, including ZNE-type homes. The most commonly performance metric reported by builders was exceeding Title 24 by a specific percentage (eight mentions). About two-fifths (6 of 16) of builders reported exceeding Title 24 by 20% to 30% when seeking to build a ZNE or ZNE-type home, with one builder reporting exceeding code by 15% and another exceeding code by 70%.

In addition to building above code, all twelve builders who built ZNE homes reported that offsetting the energy used by the home is a standard practice in ZNE home building. Among those builders, nine builders did not specify what energy source was offset in the home. Although the TRC team did not ask builders specifically about natural gas, three production builders mentioned considering *only* electricity in their definition of ZNE and performance targets. One of these builders explained they do not build “true ZNE” because of the presence of natural gas, but instead build “zero net electric” homes. The other two builders reported including natural gas in ZNE homes, because homebuyers prefer natural gas appliances. One builder who mentioned natural gas usage reported building both all electric homes and homes that use both electricity and natural gas. No builders discussed the option of overproducing electricity to compensate for natural gas usage. The industry experts interviewed also reported that the goal of zeroing out energy use can be difficult for homes with natural gas.

¹¹ BIRAenergy provides a variety of technical support to promote ZNE-type communities including: integration of energy efficiency and renewable energy technologies; working with the US Department of Energy and National Renewable Energy Laboratory (NREL); and supporting builders and developers, utilities, and industry manufacturers across the United States.

¹² CBIA is a California trade association representing homebuilders, trade contractors, architects, engineers, designers, suppliers, and other industry professionals.

¹³ ConSol provides research in systems and technologies to improve sustainability of new and existing residential developments.

Builders' Interpretations of a "ZNE Home"	Count
A ZNE home where energy is "zeroed out"	9
A ZNE electric home, where the electricity is "zeroed out" (i.e., specifically mentioned an all-electric home)	1
A ZNE home with electricity and other fuels (e.g., natural gas), but just the electricity is "zeroed out"	1
Both a ZNE electric home, where the electricity is "zeroed out" (specifically mentioned all-electric home) and a ZNE home with electricity and other fuels (e.g., natural gas), but just the electricity is "zeroed out"	1
A ZNE home with electricity and other fuels (natural gas), and all energy is "zeroed out" (i.e., produce more electric than is used, but this extra electric balances out natural gas)	0
Other definitions of ZNE, based on builders that "zero out" energy use	0
Total	12

Figure 3. Interpretations of Builders Interviewed of a ZNE Home

To meet ZNE building goals, these builders reported first focusing on energy efficiency measures and then using PV systems to achieve ZNE. Builders reported this approach reduces the costs associated with larger PV systems. (The TRC team notes there may be a self-selection bias, because the majority of builders were identified based on their work through CAHP, a program encouraging energy efficiency.) While builders did not describe conducting cost effectiveness tests, the TRC team's interpretation of this feedback was that builders following this loading order to reduce the size (and thus the cost) of a PV system.

Other ZNE-type building techniques reported by builders included:

- ◆ Maximizing the roof space available for renewable systems (5 mentions)
- ◆ Reducing the HVAC unit size (4 mentions)
- ◆ Tightening of the home's envelope (4 mentions)
- ◆ Advanced framing¹⁴ (3 mentions)
- ◆ Optimizing the orientation of the home for passive solar (3 mentions)
- ◆ High performance attics¹⁵ (2 mentions)

Builders provided a range of responses for the size of PV installed on the ZNE-type homes they have built, ranging from 2 kW to 10 kW. Builders reported that the size of the PV system depended on the size and orientation of the home, energy demand, and available roof space. A building industry expert provided a range of 5 kW to 7 kW for the installed PV systems, depending on the plug load.

¹⁴ Advanced framing is a building technique that maximizes the structure's thermal efficiency through methods that can include reducing the amount of lumber needed for new home construction (e.g., spacing wall studs at 24 inches on center rather 16 inches on center).

¹⁵ High performance attics include, for homes with HVAC equipment in the attic, strategies that minimize the temperature difference between the attic and conditioned space, and that tightly seal and insulate the HVAC system components in the attic (including plenums and ductwork).

4.1.3. Builders’ Use of Energy Efficiency Labels and Programs

The TRC team asked builders whether they have participated in the following programs for the ZNE-type homes they have built: the California Advanced Homes Program (CAHP), ENERGY STAR Homes, GreenPoint Rated (GPR), LEED, Passive House, and other programs or labels. Most commonly, builders reported participating in ENERGY STAR Homes and GreenPoint Rated, followed by CAHP and LEED. Production builders participated in CAHP most often, followed by ENERGY STAR Homes and GPR, while custom builders reported participating in ENERGY STAR, GPR, and LEED most often. Overall, custom builders reported participating in a greater diversity of certification programs than production builders did. As shown in the table below, the number of total programs is roughly three times higher than the total number of builders that responded, indicating that builders have participated in a mix of different energy efficiency labels and programs for their ZNE-type homes.

	Custom (n=7)	Production (n=8)	Production/Custom (n =1)	All (n=16)
ENERGY STAR Homes	5	4	1	10
GPR	5	4	1	10
CAHP	2	6	0	8
LEED	5	1	1	7
Passive House	3	0	1	4
Other	3	3	0	6
Total	23	18	4	45

Figure 4. Labels and Programs Used by Builders for ZNE-type Homes (Multiple Responses Allowed)¹⁶

4.1.4. Value of the HERS Label as a Communication Tool

These high-performance builders are split as to whether the California Home Energy Rating System (HERS) is a valuable tool for communicating home energy performance to the consumer. Half of builders (8 of 16) reported they discussed the California HERS index to homebuyers, while the other half did not. Two custom and two production builders stated that they use it with homebuyers, because it allows homebuyers to compare home performance. Builders who reported not communicating the HERS index to homebuyers indicated the rating system can be confusing to homebuyers. Builders elaborated on homebuyers’ confusion with the HERS index, explaining:

- ◆ “We mainly [communicate] percent above code (30% of 40%) because the HERS number is not always tangible to consumers. Using 30% to 40% above code is more intuitive.”
- ◆ “[The HERS index] is a little bit over [homebuyers’] heads.”
- ◆ “[Homebuyers] are confused because the HERS calculation changes every title revision. So someone could have had a great [HERS index] three years ago but not have one now. They don’t understand [the rating] is not static.”

The building industry experts interviewed also reported that builders have mixed perceptions of the usefulness of the California HERS as a communication tool. One expert reported that builders do communicate the California HERS index, but expressed concerned that homebuyers do not understand

¹⁶ Other labels and programs included: Build It Green (two mentions), DOE Zero Energy Ready Home, HERS Certified ZNE Home, Indoor airPLUS, Living Building Challenge, New Solar Homes Partnership, and WaterSense (one mention each).

the rating. Another building industry expert interviewed reported that builders do not use the California HERS index, but instead use the national HERS index, as developed by Residential Energy Services Network (RESNET).

4.1.5. Energy Performance of Homes Built by Builders Interviewed

The TRC team asked builders for their estimates of the total number of homes their organization has built in the past three years, how many of them were above code (i.e., energy efficient), and how many of them were ZNE. Builders used their own interpretations of ZNE when providing responses. The following table presents individual builders' responses, and total responses by different builder groups.

Builder	Builder Type	Builder's Region	Total homes built	Number of above code homes built	% of Total	Number of ZNE homes built ¹⁷	% of Total
1	Custom	Northern	3	3	100%	1	33%
2	Custom	Northern	1	1	100%	1	100%
3	Custom	Southern	1	1	100%	1	100%
4	Custom	Northern	30	30	100%	11	37%
5	Custom	Northern	5	4	80%	0	0%
6	Custom	Northern	12	2	17%	1	8%
7	Custom	Northern	15	8	53%	2	13%
8	Production	Southern	225	225	100%	1	0%
9	Production	Northern	3520	3520	100%	2	0%
10	Production	Southern	600	600	100%	1	0%
11	Production	Southern	440	440	100%	0	0%
12	Production	Northern	1	1	100%	1	100%
13	Production	Statewide	1800	1800	100%	0	0%
14	Production	Statewide	550	550	100%	0	0%
15	Production	Statewide	2000	2000	100%	3	0%
16	Production/ Custom	Northern	33	33	100%	6	18%
	Custom total		67	49	73%	17	25%
	Production total		9169	9169	100%	14	0.2%
	Northern CA total		3620	3602	99.5%	25	0.7%
	Southern CA total		1266	1266	100%	3	0.2%
	Grand Total		9236	9218	99.8%	31	0.3%

Figure 5. Number of Homes Reported Built in the Past 3 Years by Builders Interviewed

The majority of builders interviewed (13 of 16) reported that *all* of the homes they have built in the past three years exceeded code. Two of the remaining three builders reported over half of the homes they have built in the past three years exceeded code, with the remaining builder reporting 20% of the homes they built in the past three years exceeded code. Together, these builders reported building 9,236 single-family homes in the state of California during the past three years, of which nearly all (9,217) were above code. Custom builders reported building an average of 10 single-family homes during the past three years (i.e., a little over three homes per year), whereas production builders

¹⁷Some of the projects identified as ZNE by builders did not meet the study's interpretation of ZNE. The TRC team reviewed information from the builders and on the internet for the ZNE projects that builders identified and reclassified these projects as ZNE-ready, near ZNE, or ZNE (based on the study interpretations of these terms) for the study's market size estimates.

reported building an average of 1,019 single-family homes in California over the past three year (i.e., roughly 340 homes per year).

While these builders reported that almost all of their homes exceed code, they reported that the number of ZNE homes¹⁸ that they build is small. Three-quarters of builders (12 of 16) reported building at least one home in the past three years that they considered ZNE. Cumulatively, these builders reported that they have built (in the past three years) 31 single-family ZNE homes. This represents less than one percent of all homes that these builders reported that their companies constructed for that period. The three building industry experts interviewed also reported that the current ZNE market is small, consisting of fewer than 100 ZNE homes built in California in the past three years.

In addition, custom builders and builders who primarily build in Northern California reported building the majority of ZNE homes. Custom builders reported building approximately half of the reported ZNE homes (17 homes), with production builders building eight ZNE homes, and the one production/custom builder building six ZNE single-family homes (four production and two custom). Additionally, Northern California builders reporting building an average of three ZNE homes, compared to an average of one ZNE home for Central or Southern California builders. Builders who primarily build in Northern California built the majority (25 of 31) of the ZNE homes. This may be because the TRC team interviewed more Northern California builders, and/or because the Northern California builders reported to build more ZNE homes on average.

4.1.6. ZNE Home Incremental Cost

The TRC team asked builders, “Compared to a new 2,500 square foot home build to current codes, what would you estimate is the incremental cost of building the same sized ZNE home?¹⁹” For most builders (11 of 12; the remaining builders did not comment on incremental cost), there is an incremental cost associated with building ZNE homes, compared to code built homes. The TRC team asked these 11 builders to provide an estimate of the incremental cost for a 2,500 square foot ZNE home compared to a similarly sized code built home.

Builders provided a variety of estimates, as described below.

- ◆ Four custom builders who reported building at least one ZNE home provided a percentage estimate that ranged from 5% to 10%; and one estimated the incremental cost to be \$37,500.
- ◆ Four production builders who reported building at least one ZNE home estimated the incremental cost ranged from \$12,000 to \$34,000, and one estimated the incremental cost to be 5%, with an additional \$40,000 for the PV system.
- ◆ One production builder who had not built a ZNE home but reported building ZNE-ready and near ZNE homes estimated the incremental cost for a ZNE home to range from \$10,000 to \$15,000.
- ◆ The one custom and production builder who reported building at least one ZNE home estimated a ZNE home would cost approximately 15% more than a similarly sized code built home.

¹⁸ The TRC team probed specifically about ZNE homes with this question. The TRC team did not ask builder about the number of ZNE-ready or near ZNE homes they have built. In addition, the TRC team allowed builders to use their own interpretation of ZNE when responding to the question of market size. Finally, the TRC team asked builders to include homes built and underway.

¹⁹ Because this question asked respondents to compare costs to the same sized Code-built home, this question focuses on design and construction costs, not additional land costs.

Building industry experts provided similar estimates, with one indicating there is a 5% to 10% premium on ZNE homes and the others providing a range of \$35,000 to \$40,000.

Note that these incremental prices are broad-brush estimates, for reasons that include the following:

- ◆ Responses do not reflect differences in custom versus production homes, and the TRC team developed them with sale prices, not construction cost data, so they include builder mark-ups.
- ◆ The TRC team interprets these builders' responses to be somewhere between estimates based on actual construction experience and speculation. All builders who provided an incremental cost estimate, except one, had experience building ZNE homes. However, none of these builders had constructed one 2,500 square foot ZNE home and an identical code-built home; thus, these builders had to speculate to some degree on the incremental cost.
- ◆ The TRC team did not ask builders how these costs would break out between energy efficiency and distributed generation (e.g., PV), so the team could not identify to what extent these responses represent improvements in energy efficiency and adding PV, or just adding PV. However, because all of these builders reported (in response to other questions) that they used energy efficiency as part of their ZNE approach, these incremental cost responses probably reflect some additional energy efficiency measures, as well as PV.

Overall, while responses vary widely, most builders interviewed identified the incremental cost to build a ZNE home is between \$10,000 to \$40,000, and 5% to 15% of the average building cost. In general, builders active in Northern California did not provide different incremental cost estimates than builders active in Southern California.

One building industry expert also reported that he had conducted cost effectiveness calculations for climate zone 4 to compare the cost effectiveness of additional energy efficiency measures (beyond 2013 Title 24) with PV. Based on his analysis, if a home meets 2013 Title 24 requirements, PV is the next most cost effective strategy for reducing net energy consumptions, rather than additional energy efficiency measures. This building industry expert reported that these results may not hold true for other climate zones in California.

4.1.7. Homebuyer Willingness-to-pay for ZNE Homes

A minority of builders perceived that most homebuyers are willing to pay the incremental cost associated with building ZNE homes. Of the 12 builders who provided an opinion, one-third (4 of 12) reported homebuyers are willing to spend the additional money; an additional third (4 of 12) reported that a very small, select portion of the market is willing to pay for ZNE. The remaining builders (4 of 12) – all production builders – indicated homebuyers are unwilling to pay the incremental cost. As one custom builder described: “The customer who is willing to pay more is a specific segment of the market...early adopters who have an awareness and a set of values that include energy efficiency.”

Most builders (10 of 16) were unable to estimate whether ZNE homes sell faster than code-built homes. Of the six builders who offered an opinion, three reported ZNE homes sell faster, one reported they sell slower, and one reported they sell at about the same pace as code built homes. The one remaining builder noted that ZNE home sales depended on the market; that is, the speed at which ZNE homes sell depended on the level of sales within the overall market and the specific location of the home. This builder explained: “[Homebuyers] looking into entry-level houses do not have that extra money to spend, so in that market [these homes will] sell slower... Fresno is a unique market because every builder is running at the energy efficiency market at a very fast pace [due to demand]... It’s an awfully competitive market.”

A building industry expert had a similar opinion, saying that ZNE homes generally sell faster, but this varied by location. The other two building industry experts reported ZNE is currently a niche market of early adopters appealing primarily to buyers who are more affluent.

4.1.8. Marketing ZNE-type Homes

The most frequently reported marketing term used by builders to describe ZNE-type homes to homebuyers was “zero net energy” or a variation of that term (mentioned by eight of 16 builders). Two production builders reported using their own proprietary terminology when describing homes. Additional terms used by builders included “zero electric” (two mentions), “energy efficient” (two mentions), “zero new energy”²⁰, “Tier 2”²¹, “passive house”, and “zero carbon home” (one mention each).

The TRC team asked production builders how marketing messages used for ZNE homes differed from non-ZNE homes. These builders reported primarily focusing on energy performance and comfort when communicating the value of ZNE homes to buyers. Four production builders specifically mentioned discussing the energy performance of the home, typically framing the performance as a benefit and pointing to the associated financial savings for the owner. One builder explained: “We have learned to talk about energy efficiency as a benefit – reduced costs of operations, saving money, and a better investment.” Additionally, one custom and two production builders reported that communicating the increased comfort associated with homes built above code is an effective marketing message.

Builders who reported marketing energy performance have concerns about promising a specific performance. To mitigate these concerns, builders are careful with wording used in marketing materials and often include a disclaimer. One production builder emphasizes the performance is “as designed” and individual results may vary based on occupant behavior and plug loads.

The three building industry experts interviewed also expressed concerns about homebuyer expectations not aligning with the actual ZNE home performance. Experts reported that ZNE is hard to explain to homebuyers, because many homes still have natural gas bills and electric utility fees. Additionally, experts reported that, because individual energy use can vary, homebuyers could still experience expensive energy bills. One expert reported that the variation in ZNE performance and the resulting confusion for homebuyers could be a “train wreck” for the ZNE market in the future if consumers begin to distrust the terminology.

4.1.9. Drivers and Barriers for ZNE Homes

This section presents builders’ responses on what the current drivers and barriers of the residential ZNE-type home new construction market²². In general, builders reported they seek a competitive advantage by building ZNE-type homes (8 of 16 builders). Additional motivations reported by builders included the desire to innovate (six mentions) and concerns for the environment (three mentions). Only two builders, both of which were production builders, cited homebuyer demand as a motivation for building ZNE-type

²⁰ The one builder that provided this term did not elaborate on its meaning. However, this was one of three terms provided by this builder, all of which he interpreted to have “no annual kW energy demand”.

²¹ Tier 2 may refer to the requirement for meeting the higher level of incentives for the California New Homes Solar Partnership program.

²² When discussing drivers and barriers, builders did not differentiate between ZNE-ready, near ZNE, and ZNE homes due to their similarities. Accordingly, this section discusses all ZNE-type homes together.

homes. Two production builders also reported they began building ZNE homes in order to prepare for the upcoming regulatory “requirement” for ZNE.

Builders reported that concern for the environmental and financial benefits were the top two reasons why homebuyers purchase ZNE homes; however, this varied by builder type. An equal amount of custom and production builders reported environmental concern as being a primary motivation for the purchasing of ZNE and homes built above code (six mentions each). In contrast, all production builders cited the financial benefits associated with ZNE and homes built above code as homebuyer motivations, but only one custom builder and one custom/production builder reported financial benefits as a reason why homebuyers purchase ZNE homes. Industry experts reported that homebuyer motivations generally center on the financial benefits of having low utility bills.

Comfort and improved indoor air quality are additional motivating factors for homebuyers to purchase ZNE homes, according to builders. Six builders reported homebuyers are interested in purchasing these types of homes because they perceive the homes to be more comfortable and have health related benefits such as improved indoor air quality.

4.1.10. Early Adopters

Five builders reported there are specific subsets of the population to whom ZNE-type homes are specifically appealing. Four (two custom, and two production) builders said ZNE-type homes primarily appeal to homebuyers who are more affluent, with one production builder stating, “The upper end market doesn’t have a problem paying [for ZNE homes].” Two production builders reported ZNE homes also appeal to fixed-income retirees, because of the low and predictable utility bills. Thus, these builders indicated that affluent owners, and possibly older owners, may be the early adopters of ZNE-type homes.

Although there were no clear differences in motivations among builders building in different California regions, responses from two production builders that work throughout the state suggested homebuyer motivations might vary by region. One builder explained: “[Motivation] is going to be regional. For our area [Central Valley], it’s going to be energy bills. In the Bay Area, it’s more about [concern for] climate change.”

Another builder indicated the financial motivations of homebuyers, particularly in the Central Valley: “I think people want to be on the leading edge of things – especially if they can lower the costs – there are some bragging rights. A lot of [ZNE-type owners] brag about how low their monthly bill is, especially here in the Central Valley. The green element is something else they want to tote, but the economics have to be right.”

4.1.11. Current Market Barriers

A number of barriers continue to limit the adoption of ZNE-type homes in California, as described below.

4.1.11.1. Homebuyer Barriers

According to builders interviewed (9 of 16), the incremental cost associated with ZNE-type homes is a critical barrier for homebuyers. Among these builders, over half (5 of 9) reported incremental cost is the *most* critical barrier for homebuyers. Industry experts agreed that the incremental cost associated with ZNE-type homes is a major barrier for homebuyers, because (according to these experts) reduced energy bills do not always offset increases in mortgage payments. One expert went on to say that, ZNE-type homes are cost prohibitive for entry-level homebuyers, and could exacerbate equity issues in the housing market.

Homebuyer knowledge is also a barrier for the ZNE market, as reported by nine builders and the industry experts interviewed. Six builders reported that the lack of knowledge among owners has led to little perceived value of ZNE homes. One production builder highlighted the connection between homebuyer knowledge and perceived value, explaining: “Buyers still opt for granite countertops over PV, because there is an aesthetic there. When they think of renewable energy, they still think about it as if it was 20 years ago, where it cost more than it produces in value. The average buyer has just not been updated on the new benefits and financial incentives.”

Both builders and industry experts reported that the appraisal industry currently undervalues energy efficiency features and distributed generation. Five production and one custom builder reported that appraisers typically undervalue, or fail to include the value of, energy efficiency measures and PV. This practice discourages homebuyers from paying more for homes built above code. One production builder suggested leveraging the HERS index in the appraisal process, explaining: “I think [HERS] is a great tool to create consumer awareness and confidence and obviously should be leveraged to add value to the appraisal process and the underwriting, because the HERS score should be predictive of financial savings.”

Lastly, six builders reported barriers associated with PV for homebuyers. In general, builders reported that the initial cost is a barrier, although the PV lease option appears to be mitigating this barrier. However, other barriers remain. Builders reported ZNE homebuyers have concerns regarding how utilities will compensate them for excess electricity generation. A custom builder explained: “If [owners] are putting energy back into the grid, how are [utilities] going to charge for that? It is all very confusing for an owner and that needs to be worked out before they are going to buy into it. Either an owner gets money back, or a substantial credit that carries forward, and it is easy, or ZNE doesn’t make sense.”

One production builder also mentioned there are some misconceptions about the reliability of PV.

4.1.11.2. Building Industry Barriers

Builders also reported that trade knowledge is a major barrier for builders who build homes above code, including ZNE-type homes. Seven builders reported that their subcontractors often lack knowledge of the building techniques necessary for above code building, and six indicated there is a knowledge gap for other builders who do not typically build above code.²³ For example, one custom builder reported that HVAC contractors have difficulty understanding the concept of tight ductwork. Others said that the learning curve experienced by builders who do not have experience with building above code often results in increased upfront costs. The building industry experts interviewed concurred that a main challenge to building ZNE-type homes is the lack of workforce knowledge.

These builders also reported that knowledge of new building techniques among building officials and inspectors is also challenging for high performance builders, although they reported that these challenges are eroding. Six builders, four of whom were custom builders, reported experiencing issues associated with building codes and inspections. Builders reported new building techniques required for building homes above code, such as advanced framing and sealing, can create delays as building inspectors and building officials review work that is different from standard practice. However, it does appear that these issues are diminishing as these building techniques become more common and building officials gain exposure to some advanced building techniques.

²³ This finding is consistent with findings from small group discussions with building officials.

Builders also reported issues with designing and constructing ZNE-type homes. Three production builders encountered issues related to HVAC systems, with two stating that the systems currently available are often too large for the loads in ZNE-type homes. One production builder said that smaller sized HVAC systems currently do not appeal to homebuyers, and may affect the value of the home: “Buyer perception has not caught up with the energy code, so [homebuyers] feel the homes are built cheaply or not up to standards when there is a smaller HVAC system.”

One builder also mentioned that the HVAC systems they need for these homes are “exponentially more expensive” than traditional HVAC systems. Other construction and design issues reported by builders included challenges with installing ducts in conditioned space, having enough surface area on the roof for PV, and the mount and orientation of windows (one mention each). Industry experts reported similar challenges with designing and constructing ZNE-type homes, including challenges with advanced framing and high performance attics.

4.1.12. The Future ZNE Market and Recommendations for Increasing Demand

Despite the current barriers in the market, most builders and industry experts anticipate homebuyer demand and the number of ZNE-type homes that they build will increase in the next five years. Twelve of the 16 builders interviewed reported that they expect homebuyer demand for ZNE to increase in the next five years, with 11 of those builders reporting the number of ZNE homes they will build would also increase.²⁴ The remaining builders reported a steady market, and none expected a decrease in demand or production.

Builders offered a variety of suggestions on how to increase the size of the ZNE market, as described below. First, builders reported that incentives are integral to increasing ZNE market share. Five builders, all of whom were production builders, recommended continued and increased incentives to bridge the incremental cost gap associated with ZNE homes. One builder explained: “Between now and when [ZNE homes] are required, we need... to work hard to lower the costs and, in the interim, also bridge the incremental cost gap. That can be done through utility incentives specific to [ZNE homes].”

A building industry expert provided a similar recommendation, reporting that the ZNE market is approaching the gap between early adopters and the early majorities at about the same time as incentives are expiring. (The TRC team notes that, based on the market size reported by high performance builders, ZNE is less than 1% of the market, and thus still in the innovator or early adoption phase.)

Builders and industry experts offered a number of market-driven suggestions for how to increase homebuyer demand for ZNE-type homes. Five builders, four of whom were production builders, reported that improved homebuyer education would help drive the ZNE market. Two production builders who stressed consumer education suggested offering simplified marketing materials that are understandable by all levels of the market. Industry experts provided a similar suggestion. Additionally, four builders reported there is a need for more ZNE demonstration homes. One custom builder explained: “After I built my first energy efficient home, people started coming out of the woodwork. It is so much easier if they can see it and feel it. It is more real to them, rather than just some academic concept.”

²⁴ One custom builder was unable to provide a response because of the limited number of homes built.

Builders also suggested changes to distributed generation (specifically PV) policy would be important for ZNE to become more prevalent. As previously mentioned, incentive programs such as the NSHP program and PV leasing programs have been instrumental in making PV more cost-effective. However, builders reported that improvements in net energy metering policy are needed to improve PV system economics. Four builders reported experiencing owner confusion with net metering, including that owners do not understand the fees associated with net metering. Three builders recommended changes to net metering policies, including reducing these fees or moving to feed-in tariffs.

Concerns about PV have prompted at least one production builder who primarily builds in Central and Southern California to reconsider offering PV as a standard feature. This builder explained: “We have been offering PV systems as standard on our houses, but most likely will be switching to having that only as an option. We do not feel like, as a company, we are getting the most bang for the buck in terms of how much effort is needed for solar.”

Finally, four builders reported that changes to the ZNE market will only happen as policies and building regulations change. Policy and regulatory changes mentioned by builders included net metering policies and the upcoming “requirement”²⁵ for all-ZNE residential new-construction.

4.2. Program Manager Findings

The California Advanced Home Program (CAHP) program provides incentives to high performing homes (currently, minimum 15% above Title 24), with additional incentives for homes that achieve even greater efficiency. CAHP serves as the main IOU incentive program for high performance homes in California. The TRC team interviewed the program managers for the four IOUs. The TRC team also interviewed the residential program manager of the Sacramento Municipal Utility District (SMUD). Finally, TRC interviewed a staff person at Build It Green (BIG), a non-profit organization that manages the GreenPoint Rated (GPR) system, a California- specific rating system for green buildings to voluntarily obtain a third party label.

4.2.1. ZNE Terminology in the Market

Multiple program managers reported that the most prevalent terms in the market are ZNE site, ZNE source (which includes transmission costs), and ZNE Electric. In addition, ZNE Electric has two meanings; it can mean an all-electric home, or a home does not account for offsetting gas usage. Other terms heard in the market are ZNE Possible, Percent ZNE, Low Energy Home, and High Efficiency or High Performing Home.

Program managers reported that builders are wary of marketing homes as ZNE, because this can lead to unrealistic expectations of energy performance. Homebuyers expect that ZNE means zero or very low energy bills (both electric and gas), or to be entirely off the grid. As one program manager described, customers think in terms of bills and are not typically aware of fuel types or methods to offset each; they only think of PV to offset electricity use. Additionally, program managers reported that owners may not consider how their behavior (e.g., plug loads) can affect energy use. Consequently, builders mostly advertise high performance homes and near ZNE. However, some builders promote ZNE Electric, and at least one builder advertises a zero electric bill.

²⁵ The TRC team notes that the California agencies have set a goal of all-ZNE new residential construction for ZNE in its Long-Term Energy Efficiency Strategic Plan, but that this goal is not incorporated into current code. However, two builders interviewed used the word “requirement” when describing the all-ZNE goal.

In general, programs adopt terminology based on the goals of the program and what is marketable. The U.S. DOE uses the term Zero Energy Ready without specifying net energy use. BIG uses a ZNE Electric definition for its GPR rating system, because (according to the BIG staff member) homes cannot directly offset natural gas consumption.

4.2.2. ZNE Market Size and Early Adopters

Currently, the CAHP databases do not distinguish between ZNE-ready, near ZNE, and ZNE for several reasons. First, PV has not been consistently tracked historically in the CAHP databases. The CAHP databases also currently track a project's energy use compared to Title 24, rather than an energy use intensity or net energy use. However, because of the move towards ZNE, the CAHP program is moving towards an energy use intensity metric. Collective information from the CAHP program managers puts the market size of ZNE homes at approximately ten: a handful from PG&E, one from SDG&E, four from SCE, and none from SoCalGas. The BIG staff member also estimated approximately ten ZNE homes in California. However, these may not be the same ten homes; some homes may participate in CAHP and not in GPR, and vice versa. SMUD is currently working on six pilot homes to identify best practices and translate these findings into 200 homes that exceed Title 24 by at least 40%.

According to the program managers, all ZNE homes are custom projects or are "one-off" projects from production builders. Production homebuilders have generally adopted near ZNE home production for a model home or for small communities, but none has fully embraced ZNE for various barriers discussed below. However, the SMUD program manager identified one production builder that typically builds small volume developments at least 35% beyond code.

4.2.3. ZNE Drivers

There are different drivers promoting the construction and purchase of ZNE homes. Builders typically use ZNE as a marketing tool and as a way to distinguish themselves from competition. Program managers also report that some builders are experimenting with ZNE construction techniques, because they know that the energy code is heading towards ZNE. One program manager also notes that building ZNE homes can sometimes help builders receive permits, especially because of the California Environmental Quality Act (CEQA).

For homebuyers, the early adopters are motivated to purchase a ZNE home because they are environmentally progressive, and they may want to display their home within their environmental networks. Program managers believe that savings on energy bills will be the main motivation for the next generation of ZNE adopters, with a secondary driver being an increased awareness of climate change.

4.2.4. ZNE Barriers

For builders and homebuyers, the most prevalent barrier is the upfront cost of a ZNE home. Homebuyers typically purchase a home based on aesthetics and location; they must feel an "emotional hook". Most customers are not willing to pay the premiums for ZNE homes, or they would rather spend that incremental cost on visual features (e.g., granite countertops) and improved appliances. Additionally, some homebuyers are unaware of how to find a ZNE home. Finally, while homebuyers are typically willing to pay more for a home with PV, because they understand and can place value on the technology, the benefit of energy efficiency features is not always apparent to homebuyers or appraisers. To overcome these barriers, program managers suggest that ZNE promoters should educate homebuyers on the benefits, financial impacts, availability, and definition of ZNE.

Production builders will only build ZNE homes on a large scale when there is customer demand. Builders have a difficult time marketing ZNE or high efficiency features, because there is no clear ZNE definition, and homebuyers do not always understand ZNE or its financial benefits. Additional barriers for builders include a fear to change their designs and adapt to new construction practices, a fear of running into liability issues such as meeting indoor air quality requirements, and the fear of under-delivering on the customer’s interpretation of ZNE. In addition, program managers reported that builders can have face difficulty with receiving permits for homes with advanced technologies, and they have challenges with training trade allies on these practices.

Program managers all agree that to facilitate wide adoption and customer demand for ZNE homes, there needs to be a clear and consistent market definition of ZNE, so builders use common criteria, and so that owners have reasonable expectations of home performance. Programs can also provide technical advice to help builders understand advanced building practices and provide design assistance or incentives to help offset incremental costs. Homebuyers also need to understand the profound impact that their behavior plays in their home’s energy consumption.

4.2.5. Cost of ZNE

The TRC team did not specifically ask utility program managers about costs. However, several program managers offered information on incremental cost when discussing barriers for customers and builders. The TRC team probed on incremental cost estimates, when program managers identified cost as a barrier. Some program managers were hesitant to provide estimates, but provided comments on incremental cost instead. The table below provides program managers’ estimates of the cost for builders to reach ZNE as compared to a home built to code.

Role	Comment or Estimate
Program Manager 1	As Title 24 becomes more stringent, incremental cost is reduced, and ZNE becomes more cost-effective.
Program Manager 2	For production builders, using an integrative approach can manage costs.
Program Manager 3	Ranges from \$20,000 - \$50,000 depending on the project. For ZNE, the incremental cost is about \$30,000. For near ZNE homes (e.g., 35% better than 2008 Title 24), costs are fairly competitive.
Program Manager 4	ZNE is more cost feasible for production builders, because of bulk purchasing (economies of scale).
Program Manager 5	Costs generally come down with ZNE experience.
Program Manager 6	As code becomes more stringent, the incremental cost for additional efficiency features are higher per watt than installing PV. Incentives for PV are typically higher than for energy efficiency.
Residential Account Executive	\$50,000 for a standard 2,100 sf single-story home. Builders will likely use PV to meet ZNE, because it is cheaper.

Figure 6. Program Managers’ Estimates and Comments on the Incremental Cost for ZNE

4.2.6. Program Metrics for ZNE-type Homes

At the time of the CAHP program manager interviews, the CAHP program used a “percent better than code” metric, based on the 2008 Title 24 Standards. For the rollout of the new 2013 Title 24, the CAHP program is now based on HERS, using a system called a “CAHP score” that drives builders towards ZNE. The SMUD program manager also reported that SMUD programs are currently based on a “percent

better than code”, but that the new rollout of the Solar Smart program will transition to a new metric that heads towards ZNE.

The BIG staff member reported that the current GPR single-family home program has credits for 80% ZNE and 100% ZNE, based on a “ZNE electric” definition. Thus, the GPR credits do not account for fuel types besides electricity, such as natural gas. The GPR credits also account for plug loads, which is not done in CAHP or Title 24.

The TRC team also asked program managers about the use of TDV for describing ZNE-type homes. Program managers agreed that the average homebuyer does not understand TDV. However, program managers expressed different views on whether TDV should be included in the ZNE definition, and if it should be explained to owners. Some program managers support including TDV as part of the policy definition of ZNE, but do not recommend including TDV in the description of ZNE to owners. (In other words, TDV may be “under the hood”, if not advertised to the homebuyer.) On the other hand, one program manager noted that there will be false expectations in terms of bills, if TDV is included in the ZNE definition but not explained to the owner. Another suggested explaining TDV together with demand response in discussions with owners. One program manager also noted that peak demand is likely to change, so TDV will become less relevant. In general, the integration of TDV into the definition of ZNE enhances the confusion of the meaning and expectations of ZNE homes.

4.2.7. Current Utility Policies and Programs

All IOUs encourage energy efficiency and high performance homes through the CAHP incentive program. In addition, under the new CAHP program rollout, there are bonus kickers for homes with very low energy use, and for those that implement emerging technologies. The IOUs also provide PV rebates to homebuilders through the New Solar Homes Partnership (NSHP). However, the CAHP program managers report that the two programs do not always coordinate to provide joint rebates, which would ease the process for a builder to reach ZNE. Some IOU CAHP program managers report better coordination with their respective NSHP staff than others do. In addition to the NSHP incentive, CAHP has a PV kicker of \$1000. However, under the old program rollout for PG&E, builders had to meet Tier II NSHP requirements (30% above code), exceed the cooling compliance by 30%, and all homes in a development had to include PV. Therefore, few builders received the PG&E PV kicker. The CAHP program is readjusting requirements for the PV kicker, under the new CAHP score rollout.

Beyond CAHP and NSHP, each IOU has its own strategies for promoting ZNE. PG&E has a ZNE tactical plan, which looks across the utility for opportunities for promoting ZNE; this includes incentive programs such as CAHP and NSHP, the emerging technology program, codes and standards work, EM&V, and education and training. SDG&E seeks opportunities and provides support for builders to build ZNE homes for case studies. This approach allows a builder to implement ZNE features with a lower risk than if the builder were to integrate ZNE for an entire development. SoCalGas and SCE promote ZNE through Sustainable Communities, which is a ZNE research and builder grant program.

SMUD does not participate in the IOU CAHP program, but has two efforts to encourage ZNE homes: Solar Smart and Home of the Future. The program manager described these programs as encouraging near ZNE homes, rather than ZNE homes, in part because of SMUD’s concerns for the market misinterpreting ZNE. (The TRC team notes that SMUD had previously described some homes as Zero Energy Homes, in the early 2000’s, as described in the literature review - Section 2.) The Solar Smart program requires energy performance 15-20% beyond the 2008 Title 24, while Home of the Future targets energy performance 50-60% above 2008 Title 24. SMUD is currently working to launch a new version of the Solar Smart program that includes the best features from the Home of the Future.

4.3. Appraiser Interviews

This section describes findings from interviews with 11 appraisers who work in California and the TRC team industry expert with extensive knowledge of the California appraisal industry.²⁶

4.3.1. Research Objectives

The following primary research objectives guided the design, data collection, and analysis of the appraiser interviews:

- ◆ Identify the key market actors in the ZNE home appraisal process as well as their drivers and/or barriers
- ◆ Determine the role and value of energy metrics and/or rating systems for financing entities and appraisers
- ◆ Identify messaging that is used to communicate the ZNE value proposition to single-family home owners, purchasers, or lending institutions
- ◆ Identify the barriers to appraisals of new ZNE-type homes in California

4.3.2. Description of the Sample

The TRC team used several resources to identify and recruit appraisers for interviews. First, the TRC team industry expert posted a recruitment email on appraiser sites and distribution lists, and to a list of attendees that had taken a PG&E course on appraising high performance homes. Second, the TRC team contacted appraisers based on from recommendations from other parties contacted during data collection (particularly builders). In addition, the TRC team contacted appraisers with relevant training from the website for the Appraisal Institute²⁷ and appraisers listed as green building certified professionals from the Build It Green Professional Directory²⁸. The team sought to interview contacts with experience valuing energy-efficiency and/or distributed generation features present in homes built above code (including near ZNE and ZNE homes). The team conducted interviews with appraisers between May 14 and June 11, 2014. Interviews lasted from twenty to sixty minutes.

Ultimately, the TRC team conducted interviews with appraisers working throughout California, with four serving the Bay Area, one serving the Central Coast, two serving the Central Valley, and four serving Southern California.

4.3.3. Appraiser Experience with High Performance Homes

Interviewed appraisers had between 2 and 28 years of experience in the appraisal industry, with most having conducted appraisals for about ten years. Appraisers reported conducting approximately 200 appraisals per year, ranging from straightforward appraisals of production homes to complex appraisals of innovative and extremely energy efficient properties.

²⁶ Debra Little developed and teaches PG&E's course "Green Home Expertise for Real Estate Professionals," has published articles and consults on the topic of valuation of green homes, and holds designations as a BPI Certified Building Analyst, CA Certified Appraiser, and a Green Point Rater. Debra was also a member of the TRC team.

²⁷ Appraisal Institute: <http://www.myappraisalinstitute.org/findappraiser/>

²⁸ Build It Green Professional Directory, <http://www.builditgreen.org/directorylist/> Targeted appraisers had completed the Certified Green Real Estate Professional (CG-REP) designation and had the label of Real Estate Appraiser under "Professional Type" in the directory.

All interviewed appraisers reported that less than ten percent of their appraisals are of homes that are especially energy efficient, and even fewer involved valuation of PV systems (typically under two percent). Several noted that while PV is becoming more common, few homes with existing PV sell each year. Only a few appraisers reported encountering homes with other types of distributed generation, such as micro-hydro or small scale wind. Appraisers indicated that they are seeing more energy efficient homes than in previous years; however, they remain a small segment of their overall work. Appraisers mentioned that some features, such as dual paned windows, have become standard and are now considered the norm. Those involved primarily in new construction reported that energy efficient features are common in those homes.

4.3.4. Appraiser Familiarity with ZNE

Most of the appraisers interviewed (9 of 11) had at least some familiarity with the term ZNE. These appraisers offered different definitions for ZNE – generally describing a home producing as much energy as it uses – although the specific definitions varied among appraisers. Definitions offered by appraisers included:

- ◆ “ZNE is a house that has energy efficiency items in it – from PV to a building envelope upgraded to a point where there is no energy cost to live in the house. There’s a PV array that takes care of the electricity and can actually generate more energy than the house expends.”
- ◆ “Zero Net Energy means that the energy used is offset so the carbon footprint is equal to zero. Basically, the home doesn’t consume more than it creates.”
- ◆ “Zero Net Energy is a policy that means they want to make houses generate as much energy as they use.”

One appraiser and the TRC team industry expert had experience working on an appraisal for a near ZNE home, built near Los Angeles, for an Energy Upgrade California energy makeover contest. Build It Green sponsored the valuation study.

4.3.5. Appraiser Training

Appraisers had completed various trainings to learn about valuation of energy efficient homes. Appraisers reported completing related training that was offered through the Appraisal Institute, Build It Green, and PG&E. (However, the TRC team used resources from these organizations to recruit appraisers for interviews, which may have caused a bias in training results.) About half of the appraisers reported difficulty in finding training focused on valuing energy efficiency features in their region. The majority of appraisers reported actively looking for additional training and would consider additional courses if available.

4.3.6. Methods for Appraising Homes with Energy Features

Appraisers can use several methods to value homes with energy features: the market paired comparison (a.k.a., the sales comparison) approach, the income approach, and, to a limited extent, the cost approach, method. The survey method can also be used for support. These appraisers reported that they may use one or a combination of these methods, as described below.

This section describes each of these approaches. The TRC team begins by providing a background on each valuation method, and then presents feedback from the interviewed appraisers on this method.

Explanation of Sales Comparison Method: This method is based on current market data derived directly from recent, local sales of homes that are similar to the subject property. The appraiser

identifies comparable properties, and then determines if there are any unique features of the subject property that differentiates it from those comparable properties. Their next step is to answer 1. Do the unique features contribute value?, and 2. How much additional value? The appraiser then makes adjustments for the variances and reconciles them for the final valuation amount.

Appraiser Feedback: The appraisers interviewed reported that the sales comparison method is the most common method for valuing homes and is required by underwriters. However, the appraisers interviewed reported that it can be difficult to find sales of comparable homes with similar energy efficiency features. These appraisers further reported that they typically seek at least three comparable properties to support their conclusion of value; but when searching for comparable properties with energy features, it is usually a frustrating struggle to find even one. Appraisers reportedly noted the challenge of the lack of discoverable, current market data essential to the sales comparison approach.

Explanation of Income Approach: The income approach employs capitalization methods for the conversion of a potential future income stream into an indication of value. A discounted cash flow analysis is one calculation that may be utilized and has been more widely recognized as being particularly applicable to PV. Appraisers calculate the present value of (actual or projected) energy savings realized from energy efficiency and/or PV over a period of time.

Appraiser Feedback: The appraisers interviewed reported that energy efficiency and on-site energy production result in a reduction in utility bills. If available, these records provide a dollar value that appraisers can use in the valuation, and they can present a compelling argument for increased value to a home. However, if utility bills or energy use information are not available, it can be difficult to argue for a specific level of additional value attributable to energy features. Appraisers most commonly mentioned this approach when discussing strategies for valuing PV in new construction. This approach can work for energy efficiency upgrades in existing homes as well. The TRC team industry expert reported that utility bill disaggregation can be used to understand the energy savings from the pre/post utility bills.

Background on Cost Approach: This method surmises that the current cost to construct, less depreciation is an indication of value. This approach is most reliable with new construction. Depending on market conditions, depreciation is typically minimal. Valuation of newly constructed homes considers actual construction costs, land value, and entrepreneurial incentives.

Appraiser Feedback: Appraisers generally did not comment on the cost approach.

Background on Survey Method: In the survey method, the appraiser collects information from building professionals or others involved with the home to estimate or document value. Surveys are sometimes used as a way to expand an appraiser's research to discover meaningful market evidence that can be included in their rationale to support their value conclusions. With any approach, appraisers are required to perform a certain level of research and data collection in an effort to obtain sufficient support for their case. When data are scarce, a survey method might take this to a higher level, or possibly a more formal structure, and may result in market data that will be cited as secondary evidence in their report's reconciliation of value.

Appraiser Feedback: A few interviewees mentioned using the survey method for high performance homes. These appraisers reported collecting information from the real estate agent, owner, contractor, or developer about the features of a home, including "green" upgrades to determine if the upgrade likely influenced the sale. The appraisers mentioning this method indicated that it tends to result in "general impression" type information rather than documented valuation attributable to an upgrade or a feature. One appraiser explained that this method provides context and information about the perceived home value that appraisers might use to inform a quality adjustment.

Appraisers reported that other factors (including the location and condition of the home, as well as the lending environment in the area) are generally more important influences of the valuation.

- ◆ “If the developer can take the solar or additional energy efficiency features in the home and label them as upgrades with a price tag on them, and the buyer can buy [those upgrades]... those can be used as adjustments for an existing home. [But] I have to show market data about what the features are worth. And where I am, there is no market data, so I am not supposed to make an adjustment.”
- ◆ “There’s not really any documentation to use in terms of energy efficiency. If someone has solar... you can usually just count the panels and compare that. Before there can be value in these things, there needs to be data, and it needs to be about all homes—not just the one you are looking at. Lenders need proof and want to know what they are buying has actual value associated with it, and that means reliable data.”

4.3.7. Valuation of Energy Efficiency Features

The TRC team asked appraisers about valuing some specific energy features or characteristics. The TRC team presents results below. These responses were based on a mix of experience valuing homes with these energy efficiency features, and speculation:

- ◆ **Improved building envelope, such as higher levels of insulation or tighter air sealing:** Appraisers reported using actual or expected energy cost reduction resulting from the installation of insulation. A few appraisers recognized that installation of new insulation (in an existing home) or more insulation could improve and/or involve other improvements to the envelope that might enhance durability.
- ◆ **High performance windows:** Those appraisers willing to estimate a value said that this feature might add around four percent to the home value, or not more than \$5,000. However, appraisers indicated that high performance windows are becoming standard in new construction. The TRC team industry expert noted that, as they become standard, it is difficult for appraisers to differentiate value for windows as a separate element, but they can contribute to overall energy performance.
- ◆ **Higher efficiency heating, cooling, and water heating equipment:** Appraisers reported that homebuyers view higher efficiency equipment positively. One appraiser indicated that tankless water heaters are becoming more common in new homes. Another commented that solar pool heaters are a popular and valuable energy upgrade for California homes.
- ◆ **Low annual energy costs:** Appraisers indicated that they are able to incorporate lower energy costs into the valuation of an existing home, based on the savings documented by utility bills. One appraiser explained that documentation of savings in existing homes would help justify valuation for similar upgrades in new homes. The TRC team industry expert noted that, for new homes, appraisers may request the HERS index and the full report. However, as described below, none of the appraisers interviewed reported that they use the HERS index or the HERS report.
- ◆ **Water efficiency or reclaimed water systems, such as gray water systems:** Appraisers did not have extensive feedback on the valuation of water systems, but indicated that these features would be valued in a similar fashion to energy features.

Improved durability: The TRC team industry expert noted that an appraiser might recognize value in durability and its resulting extension of effective life. According to the TRC team

industry expert, this practice is not common, but it may become more common with increased appraiser education.

Appraisers further explained that the value of any feature is site specific and depends on whether the owner can demonstrate savings for upgrades they made (existing homes) or the builder can demonstrate added value from previous sales (new construction). The TRC team industry expert confirmed that providing a dollar amount or percent for a specific feature, which could apply to a majority of properties, is not standard appraisal practice. When asked about valuing ZNE homes, appraisers reported considering the total package of upgrades when determining value. These appraisers reported that ZNE homes sell for more money because of the complete package, not because of the term “ZNE”, as noted below:

- ◆ “It really ends up being part of the package. If you sat down and made a list of the factors, you can put together a list of a dozen factors. When I am looking at properties, I really am looking at all the things and it rolls into a package. So many things influence the end number value.”
- ◆ “It’s hard to say exactly how much value energy upgrades add. Any home that someone has invested in, taken care of, and upgraded is going to be more valuable. All of that plays into the value and the house will be worth more.” (The TRC team notes that this comment would primarily apply to an owner-driven energy retrofit.)

Five appraisers offered specific percentage estimates for the additional value they have seen applied to ZNE or highly energy efficient homes. These estimates were all between 5-15%, with three in the tighter 8-9% range. One appraiser described digging deeper into these features for borrowers that needed a higher loan-to-value ratio.

4.3.7.1. Valuation of PV

Appraisers identified PV as the most straightforward energy improvement to include in valuation, in part because a given homebuyer is likely to value the green attributes associated with PV, and because calculating the expected production and resulting energy costs avoided is relatively straightforward. These appraisers reported that PV is appealing to homebuyers, because homebuyers believe that PV will reliably reduce energy costs and because it is visible. Appraisers generally reported that owned (not leased) PV systems are the highest value energy upgrade that a home can have, in part because PV is more reliably included in the value of a home than efficiency features.

Appraisers reported documenting the size, production, condition, and ownership status of a PV system to determine its value. Appraisers can obtain this information through documentation provided by the owner or builder, the contractor who installed the system, PV industry experts, or from net metering data. (The TRC team industry expert also noted that appraisers can collect production information from the inverter or monitor.) Some appraisers estimate a standard market value associated with a PV system, while others use calculators to determine output. The most commonly mentioned online calculators included PV calculators offered by Sandia Labs, National Renewable Energy Laboratory (NREL), and one specific to California.

Appraisers reported that between one and ten percent of the homes they appraise have PV, with most appraisers reporting less than two percent. A few appraisers work with builders or developers who build entire housing developments where all homes have PV. For these developments, the value assigned to the PV is included in the base price of the homes. One appraiser indicated that several large builders were installing PV at every home they built prior to the financial downturn in 2007 and noted that this trend is reemerging.

4.3.7.2. Labels, Certifications, and Ratings

Appraisers' discussion of home efficiency labels, certifications, and ratings suggest that these are largely meaningless in their valuation process. While a few appraisers indicated a familiarity with the LEED label, most appraisers were largely unaware of home labels or had only seen labels like ENERGY STAR applied to appliances. Appraisers explained that there are numerous labels, including custom labels created by individual builders, many of which have no recognition in the overall market. Appraisers also noted that the use of labels and their reception by homebuyers varied by region. The TRC team industry expert added that none of the labels provides a simple "miles per gallon" type of information.

Comments included the following:

- ◆ "There are so many labels that they almost don't mean anything. That's an issue with any new industry. They need to come up with a way to fix that. It seems that he who advertises the most will ascend. It comes down to education."
- ◆ "I know that the labels have value in some areas, but it hasn't happened much around here. We had one LEED project a few years ago with a premium and it sold very quickly. That shows that there is an interest. It [could make] a positive contribution to value."
- ◆ "I think that homes with the label can affect the rating. LEED is the most common, but I do not see it very often. I do not even see them in the MLS²⁹. I would try to give a higher value to a home with a label if the market can support it, but the market has to support it. I have not seen any ENERGY STAR Homes advertised; I do not think it's recognized by the market."
- ◆ "I think that the label can affect the value. LEED is the most common, I think. But I just don't see labeled houses very often. I rarely encounter them listed in the MLS."

The appraisers interviewed also noted that some builders create their own custom labels (such as SheaXero No Electric Bill™ by Trilogy Homes). These appraisers reported that labels may draw the appraiser's attention to existing energy features and give appraisers a reason to investigate the energy performance of a given home. However, appraisers do not add a set amount or percentage to a value for homes based on labels. As with all energy efficiency and distributed generation features, appraisers must be able to document the reason for the higher value that they wish to attribute to a label and provide compelling evidence to lenders or other financial institutions.

4.3.8. Home Energy Rating Score (HERS) Index

The TRC team asked appraisers about their familiarity with the HERS index and their use of this tool in appraisals. Nearly all appraisers reported being familiar with the HERS index. However, none reported actively using the HERS index in their daily appraisal work. Comments included:

- ◆ "I am familiar with it, but I have not used it to develop any values. I was certified as a HERS rater at some point, and I may still be. I did not use it, even though I know that in some areas it is being put in the MLS. It's starting to be used by the real estate industry in some places, but there has been some resistance."
- ◆ "I am familiar with it, but have never used it. I have never run into a home that had a rating or qualifying amenities. The Build It Green certification I [took] taught me about [HERS]."
- ◆ "I have heard of it, but I don't use it or really know what it is."

²⁹ Multiple List Service (MLS).

One appraiser indicated that the HERS score may itself not be meaningful to everyone, but that the factors that feed into the score can be disaggregated to make a case for valuing energy related features. For example, the testing used to establish the score might provide evidence that the home has enhanced insulation. A few appraisers speculated that HERS scores are more widely used in Northern California than elsewhere in the state.

4.3.9. Appraiser Tools and Resources

Beyond the standard tools appraisers use in their work (spreadsheet calculators, data on comparison homes, MLS references) appraisers may also use energy-specific tools. The most commonly mentioned tool used by appraisers for energy features are calculators for PV outputs (several mentions). The Sandia laboratory version of this tool values PV by “using an income capitalization approach, which considers the present value of projected future energy production along with estimated operating and maintenance costs that are anticipated to occur during the PV module power production warranty timeframe.”³⁰ The Appraisal Institute recently released a Green and Energy Efficient Addendum, which has fields to report some of the data that can be derived from the Sandia Laboratory PV calculator. None of the interviewed appraisers mentioned this form by name, but several referred to “an Appraisal Institute form” and the Green Appraisal Program.³¹

A few appraisers interviewed have also created their own forms to capture information about energy efficiency features of homes more easily and comprehensively. These forms assist the appraisers in collecting information such as the size of PV systems, details about the insulation levels or windows in a home, and typical energy consumption.

Interviewed appraisers indicated that they might also collect utility bills before and after energy saving upgrades to serve as documentation of energy consumption in existing homes. (The TRC team industry expert explained that appraisers seek this information to verify claimed energy savings for the subject home.) Appraisers provided the following comments on using utility bills:

- ◆ “PG&E previously had a tool for getting energy costs for a home in a certain area based on certain parameters...That was a great source of data for someone like me to use because it’s unfiltered... If we can calculate the average energy costs, we can compare that to the house and what it is saving.”
- ◆ “The utility bills could be useful only if I can go to PG&E and check about the standard usage based on [the home’s] address. I can get the utility bill from the property I am appraising, but I cannot get the bill for a home that was sold, so without that information I cannot know how a home performs.”

4.3.10. Barriers to Appraisal Process

Appraisers described several barriers they face in appraising high performance homes or conveying these appraisals to lending institutions. The TRC team presents these below.

4.3.10.1. Data Acquisition and Documentation

Appraisers are required to gather data to build a case for any value they assign to a property. These data must be compelling to lenders and based on current market information, such as sales of comparable

³⁰ <http://energy.sandia.gov/>

³¹ http://www.appraisalinstitute.org/assets/1/7/AI_820_04-Residential_Green_and_Energy_Efficient_Addendum.pdf

properties. The appraisers interviewed reported difficulties with obtaining these data, in part because many of the MLS databases do not contain information about energy features and performance. They further reported that, if an MLS database does contain energy related information, it is often inconsistent, because parties recording information in the MLS may record information differently. Real estate agents choose which information to enter into the MLS and may not offer much detail about energy related features. One appraiser elaborated:

- ◆ “We do not have a proper form, so data are not kept track of, and there is no way to compare one home to another. Without this, we have no recorded baseline. You can have a very energy efficient home... but unless I have something to compare it to and get a value, it is hard to make a valuation...The lack of comparable homes sold recently is really the big barrier. Lenders require us to have that information to establish a value so the underlying issue is the lack of data... We have to build the evidence; we need to have more than a few sales to indicate a market trend.”

These appraisers reported that most MLS database do not have a standard place or way to insert documentation on a home’s energy performance features. Appraisers may add an addendum to their report specifically focused on energy related features or performance. As noted above, some appraisers have created their own forms, but this is not standard practice.

Without an industry standard for recording this information, other appraisers cannot find the data required for comparison homes to use in the sales comparison approach. The TRC team industry expert noted that as the industry (e.g., Appraisals Standards Board) develops best practices and guidelines, it may become easier for appraisers to access the data required and to recognize fair market value in their valuations.

Appraisers also expressed concerns about the time required to find the information needed to value energy features in a home. Banks and lending organizations expect appraisers to conduct appraisals quickly, making them less likely to include optional details about energy efficiency. Appraisers further explained:

- ◆ “Appraisers do not have the time to put into recording more details. If [the appraiser] is only making \$250 for an appraisal that takes two days, [the appraiser] does not want to take the time to do the additional research.”³²
- ◆ “I don’t do many new homes – most of the new homes are being done through banks and they are working with the big six tract housing builders. They work with low priced appraisers who work for the banks. Those people will do new homes for \$250, but I do them for \$400.”
- ◆ “Appraisers won’t kill themselves to go find the data—and it can just land you in underwriting hell. Everyone wants things to move fast, and you can’t really take the time [to find the data.]”
- ◆ “Banks are trying to create an assembly line for appraising properties. You cannot do justice to a home with energy efficiency or anything special about it if they do not give you the time to do it.”

The TRC team industry expert reported that an appraisal of a high performance home might take 2-3 times as much effort and time as a standard appraisal.

³² It was beyond the scope of this project to investigate standard appraisal fees and how these vary depending on geography, home type, and other factors. But the industry expert notes that this fee is on the low-end of the range for an appraisal.

4.3.10.2. Lender Knowledge and Acceptance of Appraisals

As a related barrier, appraisers described several issues relating to lenders. Appraisers indicated that only some lenders are knowledgeable about energy efficiency or PV, and that unknowledgeable lenders sometimes do not accept the value that appraisers place on these features. Appraisers also indicated that lenders generally prefer a standard approach. Multiple appraisers reported that lenders did not request a different approach for high performance homes. Appraisers provided the following comments:

- ◆ “I have not run into it, but I have heard other appraisers have been told their premium is not real. The lenders also have to be educated. If [appraisers] are asking for a higher dollar amount because of energy features, everyone has to be willing to do their part. The lender has to be comfortable that the home is worth more. If there is no market data, they won’t allow it. So it comes back to educating the market around them.”
- ◆ “The problem is that banks have taken over most of the appraisal process. The banks want to automate the appraisal and they give you very little time to do a proper analysis. They want to use computer algorithms and they just want you to follow a process.”
- ◆ “I am beginning to believe that appraisers need to be given more power or opportunity to say [a home] has a higher value, [because of high performance features]. Appraisers should have more opportunity to recognize value, even if local market evidence does not exist.”

While these issues still act as a significant barrier, appraisers reported that convincing lenders to value energy efficiency features has become easier in the past five years:

- ◆ “Five years ago or so you got a lot of flak if you tried to put value in an appraisal for energy efficiency things, but now if you make a good defense about research you have done, it’s gotten better...as long as you can show them a reasonable case that it contributes value.”

4.3.10.3. Realtor Knowledge and Education

Appraisers reported that education for all parties involved in the home buying and selling process will be necessary to facilitate accurate appraisals and to influence lending for ZNE-type homes and other homes with energy efficiency or distributed generation features. Specifically, appraisers suggested that realtors need training on how to recognize and promote energy features. Appraisers often ask realtors for energy related information about properties and find that the realtors do not have this information or an interest in it.

4.3.10.4. Consumer Demand and Knowledge

Appraisers identified lack of homebuyer demand for high performance homes as another barrier to accurate appraisals. Tied closely to the issue of lack of homebuyer demand is an overall lack of consumer knowledge about energy efficiency, how energy is used in their homes, and the cost of energy. Appraisers indicated that consumers need more education about their energy use and the likelihood that energy costs will increase over time. The appraisers interviewed suggested that knowledgeable consumers are more likely to ask their realtors and builders about energy features, request homes with these features, and expect that these features will be valued appropriately. Appraisers explained:

- ◆ “Right now energy efficiency is not part of the process. We have a place on our forms for energy efficiency, but there is no demand. People might notice a home has energy efficiency [features] and think that it is nice, but they will not make a twenty or thirty thousand-dollar decision around it; they will go for the cheaper [home].

- ◆ “The key to success is having all parts of the machine work well together. The real estate agent has to understand the elements and their benefits and communicate those values to the shoppers, and they can compare it to other houses they are considering. When this occurs [the consumer] sees the value of the features, and they speak with their dollars and they create market evidence by paying a premium. This gives the appraisers the evidence we need to take to the bank.”

4.3.11. Opportunities to Support Appraisals of Energy Efficient Homes

Appraisers identified several opportunities for reducing the barriers to appraisals of ZNE-type homes, and other types of homes with energy efficiency or distributed generation. These include additional tools for appraisers and utility support.

4.3.11.1. Tools for Appraisers

Appraisers identified several tools that would be useful for them in the process of appraising energy efficient homes. These tools included access to anonymized energy bills, utility verified calculators to determine the value range for various energy related measures, and documentation and case studies of homes with verified reduced energy costs due to upgrades. Appraiser comments included:

- ◆ “PG&E previously had a tool for getting energy costs for a home in a certain area based on certain parameters...That was a great source of data for someone like me to use because it’s unfiltered... If we can calculate the average energy costs and we can compare that to the house and what it is saving.”
- ◆ “The utility bills could be useful only if I can go to PG&E and check about the standard usage based on [the home’s] address. I can get the utility bill from the property I am appraising but I cannot get the bill for a home that was sold—without that information I cannot know how a home performs.”

She further explained that, although data are available, appraisers must obtain information via owners or account holders, which is cumbersome, and that this data would only reflect one home.

4.3.11.2. Utility support

In addition to proving access to anonymized energy bills by zip code or region, appraisers identified other support utilities could provide. First, appraisers indicated that utilities could support or create a repository of data and statistics about the energy savings resulting from various energy upgrades. This repository would store information that the appraisers could contribute to and use as documentation when valuing homes. Appraisers suggested the existing MLS could be adapted to suit this purpose. Second, utilities could provide education for the parties involved in the appraisal process—including real estate agents and lenders. Appraisers explained that, to assign a higher value to an energy efficient home, all parties must be aware of the worth of the homes features; appraisers identified the need for lender, realtor, and consumer education to this end.

4.4. Lender Interviews

PG&E contracted Cadmus to conduct and analyze interviews with lenders for this study. Because Cadmus conducted this work under a separate contract (with PG&E, not TRC as the client), Cadmus provided results in a different format than the rest of the study results. This section presents Cadmus’ deliverable to PG&E. The TRC team did not modify the findings beyond re-formatting, except in a few

instances (noted with parenthetical text). The TRC team incorporated the findings and recommendations of this section into the body of the report.

4.4.1. Introduction

Pacific Gas and Electric (PG&E) and TRC are conducting a market characterization study of the Zero Net Energy (ZNE) new construction market. In support of this study, PG&E and TRC asked Cadmus to obtain feedback from six to eight financial institutions that provide financing for ZNE home purchases. This study defines a ZNE home as highly energy efficient and capable of producing sufficient energy to offset all its needs on an annual basis. The scope of work included the following key subtasks.

- ◆ Finalize the lender interview guide.
- ◆ Develop the sample frame.
- ◆ Schedule/conduct interviews.
- ◆ Summarize the results and support their integration into the broader findings.

Cadmus has completed the interviews and is providing this high-level summary of the results.

4.4.2. Methodology

1. Finalize the lender interview guide:

Cadmus provided initial comments on the guide on June 10, 2014. We tailored the guide for a lender audience with input from TRC and PG&E and received final approval of the guide on July 18, 2014.

2. Develop the sample frame:

Cadmus, TRC, and PG&E worked together to develop a sample frame of 10 lenders. The lenders in the sample have all offered mortgage loans for new single-family homes. We chose the lenders to be representative of:

- ◆ Different energy-efficiency loan products: energy efficient mortgages (EEMs), other energy-efficiency loans, and no energy-efficiency loans;
- ◆ Large and small lenders;
- ◆ Banks and credit unions; and
- ◆ Geographic diversity.

We delivered the first draft of the sample frame on June 24, 2014, and received authorization to proceed with the interviews on July 19, 2014.

3. Schedule/conduct interviews:

Cadmus succeeded in conducting interviews with six of the 10 lenders as shown in the table below. We completed the last of the interviews on August 14, 2014. This was vacation season for many lenders, which impacted our efforts to track down and connect with the appropriate people. Cadmus was unable to connect with an appropriate person at the four lenders that were not interviewed.

#	Inter-view	Financial Institution	Branches in CA	Lender Type	Comment
1	✓	WJ Bradley	35	Mortgage Lender	An innovative national mortgage lender committed to HUD's PowerSaver ³³ loan program.
2	✓	Mason-McDuffie Mortgage Corp	19	Mortgage Lender	Involved with CalHFA's Cal-EEM + Grant ³⁴ loan program.
3		Bank of America	945	Commercial Bank	An Energy Credit Mortgage in the past offered \$1,000 credit on fees for ENERGY STAR homes.
4	✓	Cal Green Lending	1	Mortgage Broker	Website includes logos for ENERGY STAR ³⁵ , Build It Green ³⁶ , and RESNET ³⁷ .
5	✓	Umpqua Bank	102	Commercial Bank	Developing a program for energy efficient lending.
6		SAFE Credit Union	38	Credit Union	Participates in CAEATFA's ³⁸ Clean Energy Upgrade Financing Program.
7	✓	San Diego Metropolitan Credit Union	4	Credit Union	Developed their own loan program for energy efficiency and solar upgrades.
8	✓	Union Bank	366	Commercial Bank	Has expressed interest in the IOU financing pilots.
9		Cathay Bank	32	Commercial Bank	No apparent energy efficiency lending.
10		Bank of the West	255	Commercial Bank	No apparent energy efficiency lending.

Figure 7. Lender Sample Frame

Cadmus interviewed senior executives with broad lending responsibilities or senior managers responsible for sustainability initiatives and familiar with EEMs. Cadmus staff with experience in speaking with senior lenders scheduled and conducted the interviews. Most interviews were conducted by phone and took 30 minutes or less. The interview with the Chief Operating Officer of WJ Bradley was conducted in person and lasted one hour.

³³ For the U.S. Department of Housing and Urban Development (HUD) PowerSaver loan program see <http://energy.gov/eere/buildings/powersaver-loans>.

³⁴ For the California Housing Finance Agency's (CalHFA) Cal-EEM + Grant program see www.calhfa.ca.gov/ownership/programs/eem.pdf.

³⁵ For ENERGY STAR mortgages see www.energystar.gov/index.cfm?c=mortgages.energystar_mortgages. For general information on EEMs see www.energystar.gov/index.cfm?c=mortgages.energy_efficient_mortgages.

³⁶ For Build-It-Green see www.builditgreen.org/en/directories/search.asp?firstname=&lastname=&city=&state=®ionid=&searchcriteria=directory_s.ud1&searchtext=lender&submit=Submit&category=Certified+Green+Real+Estate+Professional+%28CG-REP%29&subcategory=.

³⁷ For the Residential Energy Services Network (RESNET) see www.resnet.us/professional/ratings/mortgages.

³⁸ For the California Alternative Energy and Advanced Transportation Finance Authority (CAEATFA) Clean Energy Upgrade Financing Program see http://treasurer.ca.gov/caeatfa/abx1_14. This program should not be confused with the Clean Energy Upgrade California program.

4. Summarize the results and support their integration into the broader findings:

This task included two deliverables:

- ◆ Detailed interview notes in an Excel spreadsheet; and
- ◆ A high-level summary of key findings across all interviews.

Cadmus delivered the detailed interview notes to TRC and PG&E on August 18, 2014. We scrubbed identifying information from the notes, replacing it with short generic descriptions of the institution (e.g., “a large credit union”). On August 20, 2014, Cadmus, TRC, and PG&E met briefly to review the notes and discuss next steps.

This high-level summary of results completes the current scope of work. Cadmus will remain available to answer questions about integrating these findings and recommendations with other study results.

4.4.3. Key Findings and Recommendations

Cadmus bases these findings and recommendations primarily on the ZNE lender interviews. We also bring to bear our experience with other lender interviews and with a wide range of clean energy financing models in California and nationwide. We note in this report where significant statements are based on our broader experience in addition to the ZNE interviews.

1. The mortgage lenders we interviewed all understood the concept of a ZNE home:

Their lack of interest in ZNE homes, as noted in the findings that follow, is not due to a lack of awareness of what a ZNE home is.

2. No loan products specifically targeting new or existing ZNE homes were identified:

The lenders we interviewed do not distinguish between ZNE homes and energy efficient homes in general or homes with PV. Most of these lenders see only limited demand for energy efficient mortgage products such as EEMs, and no demand for a special mortgage product just for ZNE homes. Since a standard mortgage or an EEM will work for a ZNE home, they have little incentive to create a special mortgage product for which there is minimal demand.

If lack of demand is the primary barrier to the development of special ZNE loan products, the primary motivator would be an increase in demand. The recommendation at the end of this finding offers a suggestion for how that demand might be initiated.

Lenders also see little difference between mortgages for new homes and existing homes. For new homes, there is a builder involved, and this may offer opportunities to market loans in volume, but otherwise lenders do not care whether a loan is for a new or existing home.

The one area where lenders have had some success with special energy efficiency and PV loans is with home retrofits. These loans primarily help borrowers make energy improvements to the home they already own, as with PowerSaver loans from the U.S. Department of Housing and Urban Development (HUD). In addition, energy improvement mortgages (EIMs) can help borrowers buy an existing home and wrap the cost of making improvements into the mortgage, as with HUD’s 203(k) program.³⁹ These

³⁹ For HUD 203(k) Rehabilitation Mortgage Insurance see http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/sfh/203k/203kmenu.

energy retrofit loans cannot be used to buy a new home—the 203(k) program is only for homes older than one year—except perhaps for the situation described in Finding 5.

Recommendation: Facilitate focused demand for special ZNE loan products:

Although a builder developing a ZNE neighborhood might be able to find several lenders willing to offer EEMs to homebuyers, none of the lenders would likely see enough volume to justify developing a new product specifically for ZNE homes. However, if the builder collaborated from the outset with just one lender, the undivided volume and focus might be sufficient to persuade that lender to make the necessary investment. In fact, the PowerSaver lender interviewed for this study expressed interest in just such an opportunity. PG&E should consider the possibility of connecting this lender with interested homebuilders and facilitating the discussions to show support and encourage the desired outcome. PowerSaver loans could perhaps play a role in this process, as discussed in Finding 5.

3. EEMs are suitable for new and existing ZNE homes, but are not widely offered or promoted:

As background, an energy efficient mortgage (EEM) credits a home's energy efficiency in the mortgage itself. EEMs recognize that an energy dollar saved is a dollar earned, so they allow the borrower to stretch the debt-to-income qualifying ratios on the mortgage. As a result, the borrower can qualify for a larger loan amount and a better, more energy efficient home.

Although EEMs are typically used to purchase a new home that is already energy efficient, the term EEM also encompasses EIMs, which are used to purchase an existing home and make energy-efficiency improvements. EIMs allow borrowers to include the cost of the improvements in the mortgage without increasing the required down payment.

EEMs typically require a home energy rating that estimates the monthly energy savings and the value of the energy efficiency measures. Federally insured mortgage programs from the Federal Housing Administration (FHA) and Veterans Administration (VA) offer EEMs, as do Fannie Mae and Freddie Mac in the conventional secondary mortgage market. In addition, the U.S. Environmental Protection Agency allows lenders that offer these EEMs to market themselves as ENERGY STAR Partners⁴⁰ and, if the lenders also provide special interest rates or other discounts for borrowers, to market their loans as ENERGY STAR Mortgages.⁴¹

As already noted, most lenders do not see sufficient existing or potential demand to devote resources to EEMs. Lenders make money on loan origination by standardizing and operating efficiently, so an occasional EEM is viewed more as a hassle than an opportunity. EEMs also create more work in that the lender must fill out extra forms, ask the homebuilder or buyer for the HERS rating report, help educate and guide the borrower through the process, etc.

However, two lenders mentioned a model that has evolved in the Sacramento area in which independent facilitators specialize in doing the extra work involved with an EEM. This minimizes the hassle for the lenders and avoids delaying the transaction. The lender educates the customer about the availability of the program and then refers them to the facilitator. The facilitator arranges for the BPI audit, gets the bids, reviews the project, coordinates the inspection once the work is completed, and lets

⁴⁰ For ENERGY STAR Partner information see www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_benefits_lenders.

⁴¹ For ENERGY STAR Mortgages see www.energystar.gov/index.cfm?c=mortgages.energystar_mortgages.

the lender know when to release funds to the contractor. The facilitator's fee is \$350, which can be financed into the EEM. (The TRC team notes that a HERS report, not a BPI report, is needed for an EEM.)

Although lenders could theoretically develop their own special loans for energy efficient or ZNE homes, they would have to see significantly more demand in order to make the investment worthwhile. Also, they could not go beyond the loan requirements (debt-to-income, loan-to-value, etc.) of the existing FHA, VA, and conventional EEMs unless they were willing to hold these loans and forego the option of selling them into the secondary market.

Most homebuyers are not aware of EEMs, at least not in time to help steer them to choose an energy efficient home. Buyers may not contact a lender until after they have chosen a home, and those that do contact a lender beforehand (e.g., to get pre-qualified) are unlikely to hear about EEMs. Only one lender indicated that their loan officers would suggest an EEM, and only then if the borrower happens to mention something about energy efficiency during the pre-qualification or origination process. One of the keys for leveraging the potential synergies of EEMs and ZNE homes will be to alert homebuyers to the advantages of EEMs before they have already selected the home they want to buy.

Recommendation: Work with homebuilders to help market ZNE + EEM:

One possibility for encouraging ZNE homebuilding would be to point out to homebuilders the competitive advantage they could gain from EEMs. With a ZNE home and an EEM, homebuyers can qualify for and afford a better home! Progressive homebuilders might find this useful in their marketing. PG&E should consider connecting ZNE homebuilders with EEM lenders to facilitate the development of joint marketing strategies.

Recommendation: Work with lenders to promote EEMs to homebuyers during pre-qualification:

PG&E could also point out to lenders the competitive advantage to be gained by telling borrowers how to qualify for and afford a better home. Borrowers would presumably appreciate this information and be more likely to use the lender that suggested an EEM. Note that this information needs to be shared during the pre-qualification process, not after the buyer has already selected the home they want to buy.

Recommendation: Work with real estate agents to promote EEMs, and educate real estate agents on the benefits of ZNE-type homes:

Agents are often the first point of contact for homebuyers beginning the search for a home. As such, they are in a position to steer the buyer to a ZNE home, especially if they know that an EEM can help the buyer qualify for and afford a more expensive home. The one mortgage broker that was interviewed already gives presentations to real estate agents at their regional meetings. *"You need to get the real estate agents involved. We had the agents come watch a BPI inspection so they can see the level of the inspection. It was very impactful."* While not all real estate agents will want to invest the time to observe a BPI inspection, PG&E may find it worthwhile to reach out to the California Association of Realtors[®] to explore the possibilities. A professional video of an inspection may already be available from a source such as BPI and could perhaps be almost as impactful. (As noted above, the TRC team notes that a HERS report, not a BPI report, is needed for an EEM.) Also, continuing education requirements for real estate agents may offer a vehicle for widespread training about EEMs. The California Bureau of Real Estate⁴² lists eight continuing education providers that offer courses with "green" or "energy" in the course title, including the nonprofit Build It Green. PG&E could contact these providers about including information on EEMs in their courses, and could

⁴² For the California Bureau of Real Estate see www.dre.ca.gov/Licensees/BusinessResources.html.

incent real estate agents to attend these courses by subsidizing the course fee and/or creating a public-facing web page listing the agents who complete the course. Finally, PG&E could collaborate with the Bureau to develop a guidance document on EEMs to be included under the Mortgage Lending Activities heading on the Bureau's Real Estate Business Resources web page.

Recommendation: Work with lenders to encourage expansion of the EEM facilitator model:

The two lenders who mentioned this model indicated that they were willing to answer follow-up questions as needed. One of the lenders may already be working to expand this model to other areas of California. PG&E may want to follow up with these lenders to explore how the model could be expanded statewide.

4. EEMs may be less flexible than regular mortgages:

One lender had an unexpected comment. *"It's a myth that you can borrow more on a house if it's energy efficient. HUD does offer a stretch ratio for these houses (ones that conform to the International Energy Conservation Code standards for 2000 or later⁴³), but this is misleading. The stretch does allow for increasing the combined debt-to-income ratio (DTI) from 43% to 45%,⁴⁴ but it also requires manual underwriting. Alternatively, the average borrower today can be approved using automated underwriting systems that offer more flexibility and typically allow DTIs of 47% or 48%. I've seen DTIs as high as 56%. So if an average borrower asks for a stretch ratio for energy efficiency, the maximum DTI they would be allowed would probably be lower than it would be otherwise."* Cadmus did not confirm this lender's observation that automated underwriting allows for higher DTIs, but we do know that automated underwriting is more flexible than manual underwriting and allows some borrowers to be approved that would not be approved manually.

Recommendation: Investigate whether EEMs are less flexible:

HUD's EEM Owner Guide⁴⁵ was developed for HUD by PG&E in 1996, prior to the widespread adoption of automated underwriting systems. PG&E should explore this lender's observations with HUD and, if the information is confirmed, request that HUD remove the Guide from the HUD website until it can be edited accordingly. Cadmus notes that this potential problem only applies when EEMs are used to buy a home that is already energy efficient. The stretch ratio is not involved when EEMs are used to buy a home and make upgrades. If PG&E's investigation confirms that EEMs are less flexible, the other recommendations in this summary should be re-evaluated accordingly. (The TRC team followed up on this finding with a lender, who reported that it is not accurate. The lender reported that EEMs only require manual underwriting if the buyer wishes to apply the stretch ratio provisions, but that "normal EEMs use automated underwriting".)

⁴³ For this HUD stretch ratio requirement see http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/sfh/eem/eemhog96/.

⁴⁴ For this HUD stretch ratio detail see page 8 of HUD's EEM Homeowner Guide at <http://portal.hud.gov/hudportal/documents/huddoc?id=14-02ml.pdf>.

⁴⁵ For HUD's EEM Homeowner Guide see http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/sfh/eem/eemhog96/.

5. PowerSaver could perhaps be used to encourage PV on new homes, including ZNE homes:

The PowerSaver lender we interviewed believes that PowerSaver second mortgage loans could be used to add PV to new homes that are solar-ready. This could perhaps address the appraisal issues around solar. See <http://energy.gov/eere/buildings/powersaver-loans> for more information on these PowerSaver loans.

Recommendation: Connect homebuilders interested in ZNE with PowerSaver lenders:

The PowerSaver lender expressed interest in talking with PG&E about innovative ideas for encouraging the construction of new homes with PV, including ZNE homes. They noted that builders do not want the risk of putting PV on a home before they have a buyer, since the buyer may not want PV. However, if the home is solar-ready—and this lender believes that solar-ready construction will soon be required in California—then if the buyer wanted PV the builder could finish the job of installing it and the borrower could use the new home rebate for PV for the down payment on the PowerSaver loan. The lender suggested a meeting with PG&E and large innovative builders to explore the possibilities, such as an entire neighborhood of 100+ ZNE homes.

6. Appraisal issues remain an obstacle to lending for the full value of ZNE improvements:

Two lenders noted that some appraisers are starting to include PV and/or energy efficiency in their valuations, but there has been little adoption so far. The Appraisal Institute does offer a Professional Development Program for Valuation of Sustainable Buildings, and lists on its website the members who have been through the program. Only 25 appraisers are listed for California. See more at www.myappraisalinstitute.org/findappraiser/green_sustainability_residential.aspx.

The Appraisal Institute also provides a Residential Green and Energy Efficient Addendum that can be added to an appraisal to help estimate and justify the value added by energy improvements. In prior interviews, Cadmus has heard that the additional effort to fill in this five-page form and to find appropriate comparison sales (i.e., “comps”) for reference is substantial, and that not many appraisers are willing to take on this extra effort.

However, the one lender involved with the PowerSaver program works with independent appraisers who they have trained to include PV using the Appraisal Institute's form. This lender is getting nearly dollar-for-dollar appraisals. For instance, one recent system costing \$43,000 increased the appraised value of the home by \$41,000.

In Cadmus' experience, the PowerSaver lender's efforts to get higher appraised values is not typical in the lending industry and is more a reflection of this lender's commitment to energy-efficiency/PV lending in general and to the PowerSaver program in particular. It does, however, show that higher appraised values are possible with enough effort and attention to detail.

Recommendation: Encourage appraisers to take the Appraisal Institute's Program

PG&E may want to consider a subsidy for appraisers who complete the Valuation of Sustainable Buildings Professional Development Program. PG&E could also promote these appraisers with collateral and web pages aimed at lenders, homebuilders, realtors, and homebuyers. The copy could include the link to the Appraisal Institute's list of members who have been through the program.

7. An incentive for lenders to offer EEMs for ZNE homes would not be effective by itself:

As several lenders pointed out, a subsidy on a product for which there is little demand would not be of interest. However, when combined with marketing strategies to help generate focused demand, at least one lender—the PowerSaver lender—expressed genuine interest.

4.5. Building Official & Planners Discussion and Interviews

This chapter describes findings from small group discussions and interviews with six building officials and eight planners in Northern and Southern California. The TRC team recruited building and planners using recommendations from IOU staff and their consultants, and a California Building Officials (CALBO) representative. Building officials included those that have and have not been active in ZNE-type homes, including officials who have been active in permitting homes with distributed generation and energy efficiency. The planners represented jurisdictions that have attempted to implement Reach Codes or other ordinances for energy efficiency or distributed generation; in some cases, these Reach Codes were passed in their jurisdictions, while in others, they did not.

The TRC team conducted two small group discussions, one with six building officials, and one with four planners. The TRC team also conducted individual interviews with four planners. The TRC team attempted to recruit building officials and planners representing various regions across California. However, as shown in the table below, more Northern California planners and more Southern California building officials agreed to provide feedback. Each small group discussion lasted about one hour, and interviews lasted about 20 minutes.

Region	Building officials	Planners
Northern California	1	5
Southern California	5	2
Total	6	7

Figure 8. Count of Building Officials and Planners, by Region

4.5.1. Building Official Results

4.5.1.1. Prevalence of Energy Efficiency and Distributed Generation

Building officials offered differing opinions about the current prevalence of homes built to be more efficient than code. Two building officials in the Central Valley region of California offered differing opinions about the current practice of building homes built above code. One official reported builders are reluctant to build above Title 24, because they are not required to and may not want to adopt new building practices. Another official in the same general region reported that the prevalence of homes built above code has increased over the past five years, and that this is primarily driven by utility incentives. One official located in Northern California reported that their jurisdiction has a requirement of 15% above code for new construction, which some builders exceed.

All building officials who offered an opinion reported that the number of homes with PV has increased over the past five years, although few speculated about why this might be the case. One official mentioned incentivizing PV systems by waiving fees if the system is included in the standard plan. Another official in Southern California reported that their department currently receives a handful of PV permit applications per day, up from a few per week five years ago.

4.5.1.2. Challenges with Code Compliance

All building officials reported experiencing challenges with code compliance for both homes built to code and those built above code. According to building officials, the two main sources of code compliance issues with homes built above code relate to architects and contractors. Building officials reported that architects often do not ensure that their building plans are code compliant. One official suggested that this is because architects are not aware of current codes and do very little continuing education. Building officials described challenges associated with contractor work quality as well, including the location and insulation of ductwork and compliance with Quality Insulation Installation (QII) guidelines.⁴⁶ Officials attributed these issues with a general unwillingness among contractors to change outdated building practices.

Two officials reported issues with PV compliance, indicating that installations often do not match the plan. One official explained:

- ◆ “PV installations are not always well planned out. The designers do not seem to go to the site and look at the equipment. We get out to the site and often find that the plan does not match what they are planning to do, so we have to put a stop order, and they have to make a new plan which we have to reapprove.”

Additionally, two building officials reported encountering PV systems installed by unqualified installers, which resulted in operational issues. However, officials reported that this is becoming less of an issue. Finally, one official reported the technologies used in energy efficient homes are complex and often lead to difficulties with inspections, and may cause conflict between exceeding energy code and meeting general building code requirements.

All building officials emphasized the general lack of knowledge and understanding of energy efficient building practices in the building industry at all levels (general contractors, subcontractors, architects, engineers) and suggested additional education and outreach be provided to these groups. When asked if there was a need for additional training for building officials, most officials reported having access to an ample amount of training. While they perceived training to be sufficient, building officials reported a need for more staffing support and budget resources for enforcement.

4.5.1.3. Homebuyer and Owner Knowledge

Building officials report that homebuyers do not understand the value of energy efficiency in homes. Officials speculated the lack of perceived value reduces demand for these types of homes, thereby reducing the number of energy efficient homes builders are willing to build. Additionally, these building officials reported that owners of homes built above code lack the knowledge to properly operate and maintain energy efficient features. This lack of knowledge may mean the home operates less efficiently than designed, which may cause owner frustration and higher than expected energy bills.

4.5.1.4. ZNE Awareness and Outlook

All building officials reported being familiar with the term Zero Net Energy and ZNE-type home related building practices. (The TRC team notes that it targeted building officials with ZNE-type home experience, so the broad group of building officials may not have this level of awareness.)

⁴⁶ The Quality Insulation Installation (QII) checklist is a procedure for verifying the quality of insulation and thermal barrier installation in low-rise and single-family residential buildings.

When asked about their outlook on the upcoming 2020 ZNE goal, one official reported that increased knowledge of ZNE in the market is key to increasing demand. The official expected homebuyer education would lead to an increased willingness of builders to build ZNE-type homes. Another official offered a similar view, explaining that as the market matures, and more builders begin to build ZNE-type homes, current challenges with new products and how to incorporate them into code will subside. Finally, one official indicated that he has concerns of the 2020 goal for all ZNE construction, because this would make him liable for permitting a ZNE home that may not perform as expected by the homebuyer. He reported that homebuyers must be educated that ZNE does not translate into zero utility bills.

4.5.2. Planner Results

4.5.2.1. Energy Efficiency or PV Ordinances

Most planners (six of eight) reported having an energy efficiency or PV ordinance in the area they represented. The two officials without an ordinance were both located in Southern California. Among officials who reported having an ordinance in their area, all but one reported requiring residential new construction to be a percentage above Title 24, ranging between 10% and 30%. The remaining official reported having an ordinance requiring all new commercial and residential building to have PV. Those officials who reported not having energy efficiency or PV requirements reported not doing so because of pushback from the building industry and local jurisdictions; both officials reported their area currently has no plans to adopt energy efficiency or PV ordinances in the future.

4.5.2.2. Origins and Drivers of Energy Efficiency and PV Ordinances

Planners representing areas with energy efficiency or PV ordinances reported that these were motivated by climate action plans, local politics, and a general commitment to energy efficient and sustainable building practices. One official noted that reducing carbon emissions is generally an important justification for establishing ordinances; however, evidence that the ordinance will be a good economic development tool also helped. Planners generally described the process of adopting a Reach Code as being relatively straightforward.

Most planners reported that a number of different market actors are involved in developing energy efficiency and PV ordinances, including: city representatives; the building industry; sustainability specialists; the California Building Industry Association (CBIA); California Building Officials (CALBO); utilities; and planning and environmental departments.

Officials currently see a limited role for planners in the actual development of energy efficiency and PV ordinances. One official explained that planners are currently more involved in drafting climate action plans than specific ordinances. However, one official noted that planners could have a more active role in the development of ordinances in the future. The planner explained: "I have not seen any planners involved in the actual drafting of the language. But there is the potential for that to change, as the process becomes more difficult, and the verification of the measures becomes more of a priority. I think the planners will take a more active role in the development of Reach Codes and the specific language within them in the future."

One planner noted that PV is not appropriate for every home, because of orientation or shading issues. When asked by the TRC team about community scale distributed generation, he reported that community scale PV could be an approach to meeting ZNE at a community scale.

4.5.2.3. Barriers to Implementation and Market Feedback

Most planners (four of six) who have implemented energy efficiency or PV ordinances reported experiencing barriers to enforcing and implementing ordinances. The primary barriers related to cost.

Planners reported receiving some negative market feedback from energy efficiency and PV ordinances they have implemented, mainly from the building industry and local building departments. Building industry feedback included concerns about the profitability of high performance home building and concerns with the ability to meet the requirements. The Reach Codes must also meet CEC cost effectiveness tests. Planners indicated some confusion over whether these cost effectiveness tests need to be redone after a new code is passed. For example, one planner described how his jurisdiction requires a 10% exceedance over Title 24, but another planner asked if the cost effectiveness of this requirement must be recalculated under the new (2013) Title 24.

Additionally, one official reported receiving feedback regarding burdens of compliance, especially when the Reach Codes overlaps with other codes or programs such as the California Green Building Standards (CALGreen) code or LEED checklists. Officials also reported feedback from local building departments regarding issues with prioritizing plan checking and enforcement and determining proper compliance documentation. One official explained:

- ◆ “The energy code is difficult to implement as is, and adding additional requirements to it, and determining what to look for in terms of compliance documentation, has created a challenge for building departments. This is because essentially, it says here is the new way of doing things, but we are not going to tell you how it will be done and we will not give you the tools to prepare for it. That is how it was viewed among many of the building departments.”

Additionally, two Northern California officials reported concerns with the implementation of new Reach Codes; both reported that the lack of IOU-created cost-effectiveness studies has caused local governments to look for different sources to determine cost-effectiveness. One official reported that the lack of IOU-created cost-effectiveness studies would likely result in new Reach Codes that are more measure-specific rather than tier-based. One planner described that a cost effectiveness test was done, but that the payback time determined for the proposed Reach Code was too long. However, that planner noted that the cost effectiveness calculation did not include increases in utility costs.

Finally, one official suggested that new Reach Codes should be less prescriptive and more focused on whole building energy consumption. However, this official noted that Title 24 only includes some energy loads. This planner further explained:

- ◆ “We talk about compliance, but when I look at the forms for 2013 [Reach Codes], it is amazingly byzantine... code needs to be less prescriptive, but in return, it needs to actually be experimenting with performance based outcomes having a direct legal meaning.”

Planners provided mixed responses on whether mandatory, uniform requirements (such as Reach Codes) were better than voluntary requirements. On the one hand, uniform requirements are more equitable and can be easier to implement. However, some builders prefer voluntary requirements, and these may be politically easier to pass. Jurisdictions can encourage builders to meet voluntary requirements by strategies such as waiving permitting fees.

Two planners indicated that CALGreen may have delayed progress to some degree. These planners reported that some jurisdictions did not want to develop Reach Code ordinances or other requirements, which could soon be replaced by CALGreen. Consequently, some jurisdictions did not implement a Reach Code, or suspended current Reach Codes, until the CEC finalized CALGreen. One planner spoke from the perspective of a jurisdiction that had developed and implemented their own Reach Code previously, and then replaced it with the Tier 1 requirements of CALGreen. He expressed concern that

building officials may not enforce the CALGreen measures as rigorously as the third party verifiers (e.g., LEED and GPR raters) had enforced the Reach Code requirements. This planner also noted that the development of the local Reach Code ordinance was highly collaborative (e.g., local realtors were involved), but the adoption of CALGreen Tier 1 was not.

One planner representing a jurisdiction in Marin County reported that he and his counterparts at other jurisdictions conducted cost effectiveness analysis collectively for adopting Reach Codes. The jurisdictions had similar climate zones and building types. This planner reported that Reach Code adoption was “easier to do” using this collective approach.

4.5.2.4. Training and Resources

The TRC team asked officials about the training they received about codes and ordinances, what training they provide to other market actors, and if there is a need for additional training and resources. Officials reported trainings target building industry and local building departments, and occur one year before and after the adoption of an ordinance. One official reported their department provides a training that focuses on the constrained nature of building departments and how to prioritize plan check and enforcement. Officials reported a general need for more training on codes and training for the planning community to assist in their understanding of the role that Reach Codes can have in meeting climate action goals. One official reported that training is sufficient, but is often located in areas that are not easily assessable for individuals not located near a major city.

4.5.2.5. ZNE Awareness and Outlook

All of the planners interviewed were aware of the term ZNE. Planners offered a variety of recommendations regarding ZNE home building and related ordinances. One planner indicated that establishing relationships with builders is key to increased ZNE adoption. The official explained there is a need for additional education for the building industry on how to build ZNE homes and how they can be profitable. One official reported there is a general lack of information regarding ZNE homebuilding available to builders, and as a result, few projects in California are truly ZNE. Another official reported having concerns about how to mandate PV when some lots do not allow for PV systems due to the lack of direct sunlight. One official mentioned there being two jurisdictions in California that are currently perusing the analysis of local ordinances for ZNE Reach Codes – the City of Berkley and Palo Alto.

These planners indicated that a requirement for ZNE construction would not be politically feasible for their jurisdiction at this time, and they would need to understand the impact of ZNE on cost effectiveness. Planners also indicated that their jurisdictions are “waiting and seeing” what happens at the state level for ZNE. Thus, at this time, none of the planners reported that their jurisdictions currently plan to adopt a ZNE ordinance.

One planner noted that ZNE is not feasible for all homes, because of orientation or lack of roof space. When prompted by the discussion moderator to discuss community scale generation, the planner noted that community scale generation could potentially be used to solve this issue.

4.6. Interviews with ZNE-type owners

This section presents results from phone interviews with ZNE-type owners. While these interviews included several open-ended questions, the guide also included several coded questions, so that the TRC team could more directly compare results of these interviews with results from surveys of Energy Efficient owners.

4.6.1. Research Objectives

The following primary research objectives guided the design, data collection, and analysis of the interviews with ZNE-type owners:

- ◆ Document reasons for purchasing a ZNE-type home
- ◆ Assess drivers, barriers, and opportunities for ZNE messaging, including what messaging has been used to communicate the ZNE value proposition to the single-family residential new construction market
- ◆ Investigate owner awareness of, and views on, the energy rating of the home
- ◆ Characterize owners living in ZNE-type homes

4.6.2. Methods

4.6.2.1. Sample and Interview Guide

The TRC team developed a list of owners in ZNE-type homes primarily using the PG&E, SCE, and SoCalGas California Advanced Homes Program (CAHP) databases (source of 275 contacts and 36 completed interviews). (SDG&E initiated new customer privacy policies at the start of the study and was not able to provide its CAHP database for the owner interviews.) The TRC team also identified contact information for seven owners in custom ZNE-type homes through the RFI, and completed interviews with all seven owners.

The TRC team defined ZNE-type homes as those in the SCE and SoCalGas databases as ZNE-type that were 35% more efficient than Title 24 and had PV, or were 40% more efficient than Title 24. The TRC team identifies homes in the PG&E database as ZNE-type homes if they were at least 40% more efficient than Title 24. The TRC team used different criteria to ensure that enough homes were identified to complete the target number of interviews from Southern and Northern California (approximately twenty each). Because some of the databases included homes dating back to 2006, and the databases were provided by July 2014, this performance generally represented a mix of homes built to be at least 35% above the 2005 Title 24 and the 2008 Title 24. The TRC identified the entire population of PG&E, SoCalGas, and SCE homes that met the energy performance criteria described above, because these populations were approximately equal to the number of homes needed for the survey. (In other words, the TRC team did not need to develop a sample, but rather used a census.) The TRC team removed duplicates between SoCalGas and the other IOUs. The TRC team then sent this list of addresses to the IOUs, and the IOUs provided owner names and contact information for these homes.

The table below presents the number of completed interviews with ZNE-type owners by location, home type, and energy performance. The Northern California owners were from the PG&E database, while the Southern California owners were from SoCalGas and SCE databases. Of the 43 owners interviewed, the TRC team classified four of their homes as ZNE-ready (i.e., very efficient but no distributed generation), 34 as near ZNE (i.e., very efficient and has distributed generation – all of which was PV), and five as ZNE. The ZNE homes include one that is still under construction, but that is planned to be ZNE. The near ZNE interviews included two that were retrofits. In general, the TRC team used purposive sampling to identify sample of owners with specific experiences, rather than representative of the larger population.

Geography		Home Type		Energy Performance			Total
Northern CA	Southern CA	Custom	Production	ZNE-ready	Near ZNE	ZNE	
28	15	16	27	4	34	5	43 ⁴⁷

Figure 9. Description of ZNE-type owners Interviewed

The interviews occurred in July and August of 2014. Interviews lasted between twenty to thirty minutes. The interview guide was semi-structured (including both open-ended and closed-ended questions). The number of closed-ended questions was determined based on the value of obtaining quantifiable responses for certain topics.

4.6.2.2. Home and Owner Characteristics

ZNE-type homes in the sample had about four bedrooms and three occupants, on average. Most (38 of 43) homes were built in the past four years, four were built between 2005 and 2010, and one was built in 1978. The owner of the home built in 1978 extensively remodeled that home several years ago to make it a ZNE-type home.⁴⁸

Nearly all owners (24 of 26)⁴⁹ reported being the first owners and occupants of their home. (However, this result may be because the homes identified were relatively new homes.) All but two owners living in custom-built homes reported being involved in selecting the energy efficient features of their homes.

4.6.3. Purchase Motivations, Energy Messaging, and Rating Systems

This section presents results from several different questions to ZNE-type owners regarding the home features they considered when purchasing⁵⁰ a home, the priorities they placed on certain features, and which of these features were most important.

Figure 10 shows interviewees’ open-ended responses to the question, “What home features or characteristics were critically important in your decision to buy this home?” (Respondents were allowed to provide multiple responses.) The figure also shows responses to the follow-up question, asking respondents to identify the most important feature considered.

⁴⁷ One interview of a production, near ZNE owner in Northern California was partially completed.

⁴⁸ The scope of this study was new construction. However, the TRC team included responses from this homeowner when examining the data, because this homeowner provided valuable feedback about his reasons for wanting a ZNE-type home and how the remodeled home was valued when it was re-financed.

⁴⁹ Because the TRC team added this question midway through the data collection process, only 26 owners reported this information.

⁵⁰ For custom owners, the interviewer rephrased questions regarding “purchasing a home” as “designing the home”.

Home Features	Features Considered (multiple responses allowed)			The most important features of those considered ⁵¹		
	Custom or Spec Homes (n=18)	Production Homes (n=24)	All Homes (n=42)	Custom or Spec Homes (n=18)	Production Homes (n=24)	All Homes (n=42)
Energy efficiency/ green features (insulation, tankless water heater, etc.) or energy efficient home design	11 (61%)	10 (42%)	21 (50%)	8 (44%)	4 (17%)	12 (29%)
Location	2 (11%)	16 (67%)	18 (43%)	1 (6%)	9 (38%)	10 (24%)
Price	1 (6%)	9 (38%)	10 (24%)	2 (11%)	7 (29%)	9 (21%)
Solar panels	6 (33%)	7 (29%)	13 (31%)	2 (11%)	3 (13%)	5 (12%)
Size of the home, layout, or structure	2 (11%)	7 (29%)	9 (21%)	0 (0%)	5 (21%)	5 (12%)
Newly constructed home	0 (0%)	6 (25%)	6 (14%)	0 (0%)	3 (13%)	3 (7%)
Living in a sustainable home/ low energy footprint home	3 (17%)	0 (0%)	3 (7%)	2 (11%)	0 (0%)	2 (5%)
Financial benefits (e.g., lower or no utility bills)	5 (28%)	2 (8%)	7 (17%)	2 (11%)	0 (0%)	2 (5%)
Automation/ being able to control equipment or appliances	6%	0%	1 (2%)	1 (6%)	0%	1 (2%)
Whole experience/ all the features	-	-	-	1 (6%)	0 (0%)	1 (2%)

Figure 10. Features Considered by ZNE-type Owners When Purchasing Their Home, n=42

Looking across all types of owners, energy efficiency features, location, and price of the home were the three most important considerations for owners when they were making their decision to purchase their home. However, the data indicates that responses vary by whether the owner purchased a custom or a production home. For example, 44% of custom owners identified energy efficiency features as the most important feature; the remainder of custom owners were split on which feature was most important (price, PV panels, sustainable home, and financial benefits all received two responses, and location and whole experience received one response). In contrast, 29% and 21% of production owners identified price and layout as the most important feature, respectively, and only 17% reported energy efficiency features as the most important feature. Similarly, nearly one-third (7 of 24) of owners living in production-built homes noted price as the most important consideration when deciding to buy their home, compared to one-tenth (2 of 18) of owners living in custom-built or spec homes.

The TRC team also provided a list of specific features associated with a ZNE-type home, and asked owners to rate each feature as to whether it had a “high,” “medium,” or “low” level of importance or was “not a consideration at all” in their decision to buy or design their home.

⁵¹ Some owners provided more than one response to this question. Consequently, the total number of responses is greater than the n-value

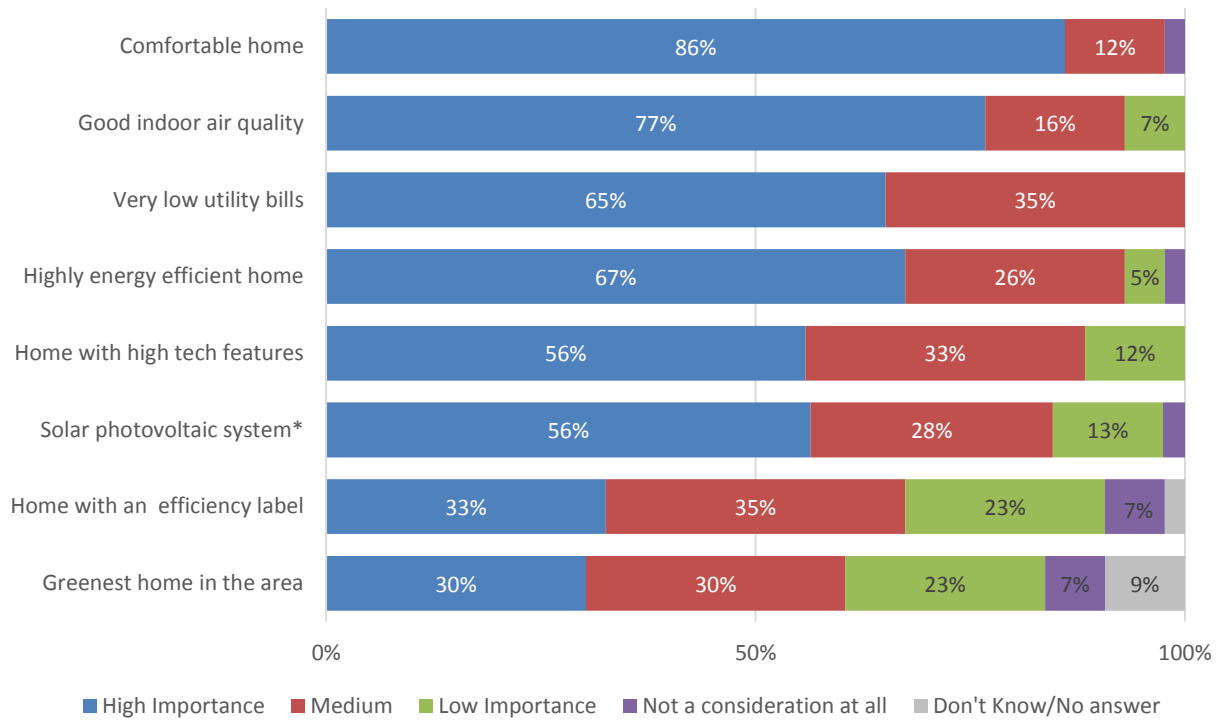


Figure 11. Level presents results. Most owners rated all of the prompted features as highly or moderately important in their decision to buy or design their home. Figure 37 also shows that comfort received the highest rating (86% rated comfort as having a “high” level of importance), although none of the owners called this feature out in the open-ended question asking which features they sought when purchasing a home (see Figure 10).

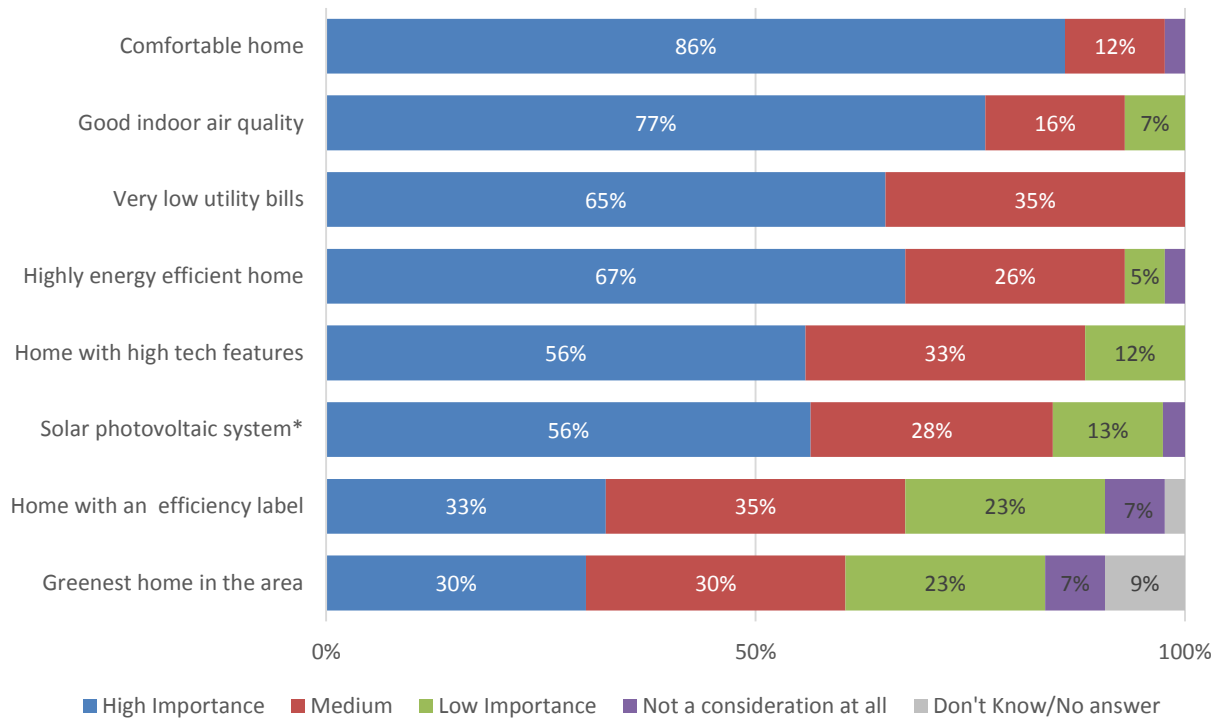


Figure 11. Level of Importance of ZNE-type Home Features in the Home Buying or Design Process, n=43⁵²

When asked which of these features were the most important, owners rated energy elements (energy efficiency, PV, and very low utility bills) the highest, followed by comfort and high tech features. Good indoor air quality was much lower. Thus, for this group, while nearly everyone valued comfort and indoor air quality, the majority valued energy elements more. Also, respondents were divided equally between ranking high-energy efficiency and PV as the most important feature.

FEATURES	Count	Percent
Highly energy efficient home	9	21%
PV system	9	21%
Very Low Utility Bills	8	19%
Comfortable home	5	12%
High tech features like the latest appliances or energy efficient technologies	4	9%
Good indoor air quality	1	2%
The greenest home in the area	0	0%
Other	2	5%
None of them	1	2%
No answer given	4	9%

Figure 12. Most Important Feature of Those They Rated, n=43

⁵² The number of owners rating this item was 39, because those who owned homes without PV did not rate it.

Further assessment of this data revealed one noteworthy response difference by region: Owning a home equipped with PV was more important to those living in Southern than Northern California. Nearly half (6 of 15) of those living in Southern California and one-tenth (3 of 28) of those living in Northern California reported PV was the most important of the features they rated.

Nearly all (39 of 43) owners reported that their home is equipped with PV. All of the homes without a PV were production-built homes. One of these owners considered installing PV, but chose not to after seeing the price the builder wanted for the PV package. This owner also explained not wanting to invest in PV because they planned to rent the home.

4.6.4. Energy Messaging and Rating Systems

The TRC team listed several common energy efficiency programs and/or descriptions and asked owners if any of those were used to describe their home at the time they considered buying their home. As shown in the figure below, owners most commonly recalled their home being described to them as a highly energy efficient house, a solar house, or an ENERGY STAR certified home.

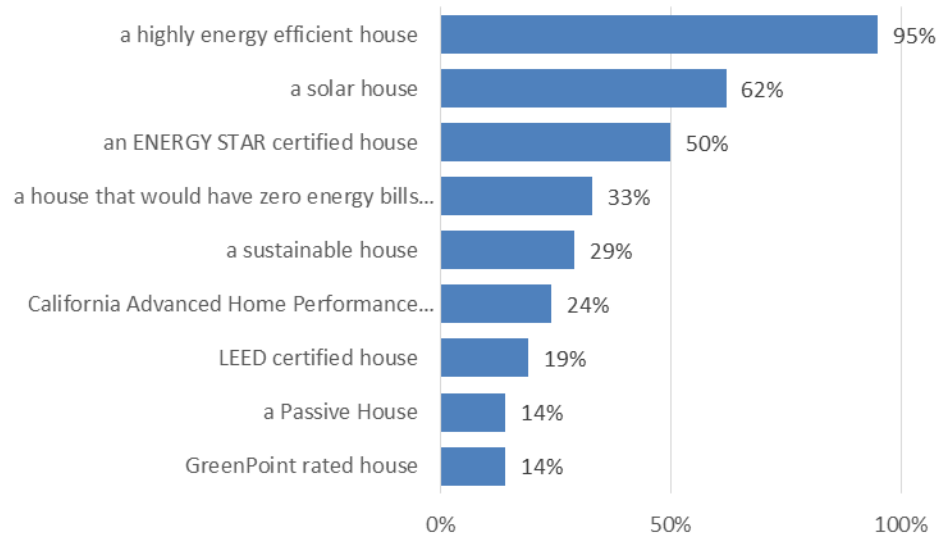


Figure 13. Percentage of ZNE-type owners Reporting If These Descriptions Were Used to Describe Their Home, n=42^{53,54}

Among four owners who owned homes without a PV system, three said their home was not described to them as a solar home, and one said that their home was. This owner considered solar, but chose not to install it when discussing with the builder which add-on features he or she wanted for their home.

When asked if energy efficiency of their home was described to them in any other way, six owners reported receiving information about specific efficient equipment or materials. Three noted hearing about “low utility bills” when their home was described to them, and two explained their home was described to them as a “green” home. Additional home descriptions mentioned by owners included

⁵³ Among four owners who owned homes without a PV system, three said their home was not described to them as a solar home, and one said that their home was. This owner considered solar, but chose not to install it when discussing with the builder which add-on features he or she wanted for their home

⁵⁴ One homeowner interview was partially completed; this homeowner did not answer this question.

“HERS rated” “Tier 1 or Tier 2,” “zero net electric,” “80-90% savings,” “tax deduction for solar,” and “100% electrical needs powered by solar” (one mention each).

When asked which of the energy-related descriptions were the most influential in either their home buying decision or the design process, owners most commonly cited a highly energy efficient house and a solar house (Table 12).

DESCRIPTOR	Count	Percent of Total Owners
a highly energy efficient house	10	33%
as a solar house	7	23%
a house that would have zero energy bills or a Zero Net Energy house	3	10%
a Passive House	2	7%
Low utility bills	2	7%
an ENERGY STAR certified house	1	3%
a GreenPoint rated house	1	3%
Other	2	7%
None	2	7%

Figure 14. Most Influential ZNE-type Home Feature in the Home Buying or Design Process (n=30⁵⁵)⁵⁶

Twenty-one owners indicated receiving an energy rating score, or a description of their home’s expected energy performance. Ten of these owners reported receiving a HERS rating, one mentioned having a Passive House performance spreadsheet used to track the performance of their home, and the remainder could not recall the name or any detail about the energy rating material they received. One near ZNE owner living in a custom home, who reported not receiving any energy rating material, conducted his own energy modeling on various aspects of the home plan and design.

Among owners who reported receiving a HERS rating, only three recalled details when asked what information was described in those materials, reporting: 1) their home was compared to other homes; 2) the energy savings were quantified; and 3) a score they received was based on many pieces of information about home features without specifying any more detail.

A few owners mentioned the energy rating or energy-related information was useful. Two owners noted they needed a HERS rating report to qualify for rebates and/or tax credits, which enabled them to receive the incentives and offset the cost of building their home. One near ZNE owner explained that they have monitored their energy usage after they moved into the house, which shows all of their electricity, natural gas, and water usage.

4.6.5. Loan and Appraisal Process

Most (36 of 43) owners reported obtaining a bank loan to purchase their home, six used cash, and one did not report this information. Among those who obtained a loan, most (34 of 36) reported having no

⁵⁵ The TRC team added this question after the data collection process started, and thus, not all were asked this question.

⁵⁶ “Other” responses included all the green features of the home combined and being considered Tier 2 under Title 24 (one mention each).

issues with the loan. For the two owners who had issues, one explained they barely qualified for the loan, while the other reported having an issue without specifying any more detail. Additionally, the TRC team asked these interviewees if they used an Energy Efficiency Mortgage (EEM) or other type of energy efficiency financing when they bought their home, and none reported that they had.

A couple of ZNE-type owners reported that the energy features of the home did not lead to a higher valuation during the appraisal process. One owner that remodeled his home to make it a near ZNE home, also obtained no additional benefits from the energy features in the appraisal when he re-financed, explaining: “We did refinance 5 years ago, and the fact that it was a Zero Net Cost home, was just a footnote. It wasn’t taken into account into the appraisal and I think it should have been.”

4.6.6. Experience Living in a ZNE-type Home

4.6.6.1. Expectations and Owner Satisfaction

The TRC asked these owners what their expectations were for their ZNE-type homes at the time of purchase, and whether these expectations had been met.

These owners primarily reported expecting low energy bills (26 mentions) and having a comfortable home (13 mentions), when asked what expectations they had for living in a highly efficient home. Additional expectations mentioned by owners included having good ventilation (3 mentions), an energy efficient home (2 mentions), working equipment (2 mentions), and a home that is simple to maintain (2 mentions).

More than half (29 of 43) of owners reported that their expectations have been met. When asked what they liked the most about their home, owners cited comfort (15 mentions), location (11 mentions), and low energy bills (8 mentions).

Seven reported that their expectations have *not* been or have been *partially* met, citing:

- ◆ Utility bills higher than expected (2 mentions)
- ◆ An annual electric utility bill at the end of the year for several hundred dollars, which was a surprise (1 mention)⁵⁷
- ◆ The house using more energy than the prior one, which was only 700 square feet smaller (1 mention)
- ◆ The surcharge for the PV on their utility bill (1 mention)
- ◆ Issues with E-coli in the well water (1 mention)
- ◆ No air blowing from the vents when air-conditioning or heat is on (1 mention)

When asked what they liked the least about their home, six owners noted disliking certain features or lack of features associated with either energy efficient technologies or construction materials used in their home (e.g., disliking water pressure of low-flow faucets or “cheap” plumbing products). Others noted disliking the small lot size (4 mentions), home layout (3 mentions), the big annual bill from the

⁵⁷ This homeowner explained that they pay a very small amount every month, and then once a year are given “a very large bill.” This homeowner described this end-of year bill as “cheap when divided by 12,” but unexpected, which made them upset.

utility (3 mentions), managing high tech features (2 mentions), and additional cleaning associated with a bigger home (2 mentions).

Fifteen owners would recommend a friend consider buying a ZNE-type home, if that friend were to ask them about buying a ZNE home. Owners also reported they would advise their friend to do the research, investigate incentives for energy efficient technologies offered by the utilities, be comfortable with the price and debt, and, if designing their home, select the right professionals, materials, technologies, or architectural designs.

4.6.6.2. Concerns with a ZNE-type Home

The TRC team asked owners whether they were “highly,” “somewhat,” or “not at all concerned” about several potential issues at the time of initial purchase. The figure below present’s results, with these results split out by custom and production owners. The majority of owners identified the initial cost of the home as the main concern. In addition, almost half (48%) of the production owners were concerned about resale value, and almost half (47%) of the custom owners were concerned about sufficient ventilation. About one-quarter of both types of owners identified the ability to manage high tech features as an initial concern.

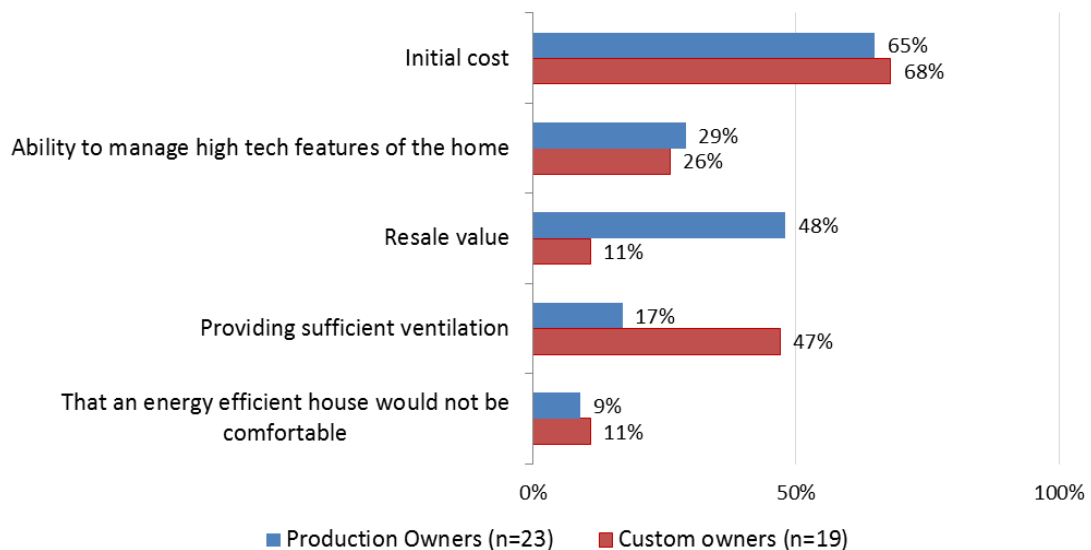


Figure 15. Percentage of ZNE-type owners that Reported Being “Highly” or “Somewhat” Concerned about Issues, n=42⁵⁸

When asked whether they had any other concerns because their home was a ZNE-type home, three owners noted a few additional concerns. These were:

- ◆ Not confident that the builder knew how to properly install PV technology (certain valves were installed inappropriately resulting in lower than optimal PV system productivity) (1 mention)
- ◆ Concerned about the cost of making their home LEED certified (1 mention)
- ◆ Frustrated with the spray home insulation, because it was impossible to do any wiring in the wall (1 mention)

⁵⁸ One production homeowner interview was partially completed; this homeowner did not answer this question.

Owners reported that various market actors addressed their concerns – builders, contractors, architects, realtor, sales staff, family, or prior owners. When asked what information addressed or reduced their concerns, owners described:

- ◆ Receiving a confirmation that the resale value of their home will likely be higher than what they paid for it (i.e., saw other homes sell for more, conducted research and observed that energy efficiency features sell for more, learned from appraisers their home will appreciate in value) (4 mentions)
- ◆ Assessing expected costs and budgets or researching costs of materials and/or equipment to ensure they can afford the home (4 mentions),
- ◆ Receiving pertinent information about the technologies they have in their homes (either catalog or information from those knowledgeable about the technologies) (2 mentions)
- ◆ Having a 10-year warranty on the PV system (2 mentions)

There were two additional noteworthy comments about owners' comments on the resale value of their home. One owner noted the price of their home had to be reduced by \$20,000 by the builder, when the appraised value of their home was identified as lower than the sale price. (According to this respondent, the appraiser undervalued the PV system.) Another owner noted that neighboring homes were selling without energy efficiency features, which concerned them.

4.6.6.3. Equipment Training and/or Information

The owners interviewed reported that builders, PV contractors, or others provided them with training on a variety of technologies, including:

- ◆ PV (10 mentions)
- ◆ HVAC or thermostat (3 mentions)
- ◆ Water heater or another appliance (3 mentions)
- ◆ Heat recovery ventilator (1 mention)

Some noted receiving a booklet, pamphlet, or a manual with information on energy efficient and/or PV technologies in their homes. Almost all of these owners reported that this training and information was helpful. But only a few explained why, noting it helped them “change individual room temperatures and check on the solar output,” “choose among [equipment] options and make changes,” or learn that the “hot water system was not set up right.” One of these respondents also reported it was not necessary to learn about the intricacies of the equipment explaining: “I don't need to know how the heat exchanger works. We don't know how a TV works, but we know how to use it!”

Three owners indicated either not understanding or needing additional training on how to use PV, heat recovery ventilator, or other technologies. One owner who found training and information they received useful still had questions about certain aspects of maintaining their PV system, saying: “We aren't sure on whether and how often to wash the PV panels. Will it really improve performance?”

4.6.7. Owner Interpretation of ZNE

Respondents' awareness of the term ZNE differed by home type. Nearly all owners (18 of 19) living in custom or spec homes reported being aware of ZNE, whereas less than half (11 of 24) of those living in production homes were aware of this term. Overall, less than one-third (28%) of these owners reported being familiar with the term “Zero Net Energy”.

When asked to explain what ZNE meant to them, owners' responses included:

- ◆ ZNE means the house does not use/consume more energy than it produces (11 of 29)
- ◆ ZNE means "zero cost" energy and/or zero utility bills (8 of 29)
- ◆ ZNE means nearly off the grid or self-sufficient – that is, not needing any outside power source (4 of 29)
- ◆ ZNE means "cheaper" or "lower" energy and/or utility bills (2 of 29)

Eight of these 29 owners explained that ZNE refers to both gas and electricity, and a couple expressed a disbelief that a ZNE goal is attainable, saying:

- ◆ "Zero Net Energy is a goal that is unachievable, but a very low cost per month of energy is feasible. The power companies have us all on tiers, and so keeping the summer cooling costs down to minimum was doable. I don't think zero energy bill is achievable." (owner of a near ZNE production home)
- ◆ "To me, it basically is an impossible goal that gets thrown around... no one really knows how hard it is to get there. It is a great goal but lot of homes will not reach it, and the term should not be thrown around lightly...The general size of home roofs is NOT BIG enough. I have seen that in my practice [architect], covering the entire roof with PV gets to about 75% of net energy needed." (owner of a ZNE home)

4.6.8. Owners' Reported Value of ZNE-type Homes

Interviewed owners perceived that their ZNE-type home would sell for more than a comparable but code-compliant home. Most (36 of 42)⁵⁹ owners reported that the energy features of their home would cause it to sell for more, compared to a home in the same location and of the same size but with standard energy performance. Six reported their home would sell for about the same, and none reported that their home would sell for less. Four of the six respondents who believed their home would sell for about the same lived in Southern California.

Those who reported their ZNE-type home would sell for more than a similar code-compliant home provided an estimate of how much more. Their estimates ranged from 9-12% more, with an average of 9% - that is, these owners estimated their home would sell by about 9% more on average than a comparable home with standard energy performance. ZNE owners provided the highest estimates, reporting their home would sell by 12% more, on average, whereas production near ZNE owners provided the lowest estimates, reporting their home would sell for about 9% more, on average. Custom near ZNE owners reported their home would sell for about 10% more, on average. (Because the majority of owners in these interviews lived in near ZNE production homes, and because of rounding, the average incremental sales price for all ZNE-type owners is the same as the average incremental sales price for production near ZNE owners.)

When asked how much of a priority they would put on purchasing a ZNE-type home in the future, most owners of all types (i.e., custom-built, spec, or production owners) reported they would place a "high" priority on a ZNE-type home if they were buying another home (Figure 16).

⁵⁹ One homeowner interview was partially completed; this homeowner did not answer this question.

Priority of obtaining high energy performance in future home purchase	Custom Owners (n=19)	Production Owners (n=23)	All (n=42) ⁶⁰
High priority	14	17	31 (74%)
Medium	3	2	5 (12%)
Low	1	4	5 (12%)
No priority	1	-	1 (2%)

Figure 16. Owner priority for buying a ZNE-type home in the future

When asked how much more they would be willing to spend up-front on their next home for it to be high-energy performance home, compared to an otherwise similar code-compliant home, the 35 owners providing an estimate reported they would be willing to spend about 10% more on average. Owners living in custom-built or spec homes were willing to spend 12% more on average, whereas owners living in production-built homes reported that they would be willing to spend 8% more. Those living in Northern California were willing to spend more up-front (11% more, on average) than those living in Southern California (9% more, on average).

In the figure below, the TRC team graphed the relationship between respondents’ estimates of how much more their ZNE-type home would sell for compared to a code-compliant home, and how much more they are willing to spend for their next home to be a ZNE-type home compared to a code-compliant home.

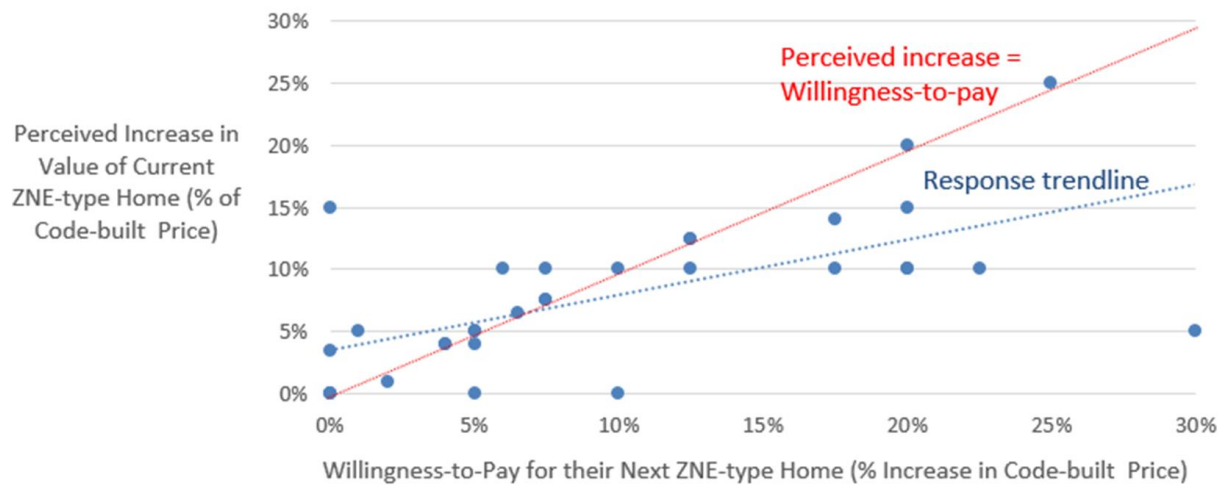


Figure 17. Comparison of ZNE-type owners: Responses of their Expected Incremental Sales Price, and the Incremental Price they are Willing to Pay for Their Next ZNE-type Home, n=32⁶¹

Figure 17 shows a positive, linear relationship between owners’ perceived value of how much more their home would sell for and their willingness-to-pay for a ZNE-type home. In other words, the more value owners attribute to their home’s energy features, the more they are willing to pay for a ZNE-type

⁶⁰ One homeowner did not answer this question.

⁶¹ Only 32 owners gave both estimates – that is, how much more their home would sell for (in terms of a percentage) and how much more they are willing to pay for a ZNE-type home, compared to a code-compliant home. The figure shows fewer than 32 data points, because some owners provided the same response.

home. The figure also shows that the data-based trend-line is below the one-to-one line (where expected incremental sales price equal the reported willingness-to-pay). Thus, the majority owners report they are willing to pay more for their next home to be a ZNE-type home, than they expect to receive as an incremental sales price.

4.7. Forum with ZNE-type owners

4.7.1. Research Objectives

The following table summarizes the research questions explored during the discussion with ZNE-type owners.

RESEARCH QUESTIONS
Who are the early adopters of ZNE and near ZNE?
What messaging has been used to communicate the ZNE value proposition to the single-family residential new construction market? Which have been successful?
Who are the key market actors in the ZNE process? What are the major drivers and barriers for each?

Figure 18. Research Objectives for ZNE-type Forum

4.7.2. Description of the Sample and Recruitment Method

The TRC team recruited participants from two communities in the Sacramento area that included approximately 200 near ZNE homes. TRC recruited owners in the first community (“Community A”) through an owner association email list and through flyers sent in the mail. TRC recruited owners in the second community (“Community B”) through an owner association email list. Participants were offered a cash incentive for participating in the forum.

Four owners attended the forum. Three of the four attendees lived in Community A while one attendee represented Community B. The forum was held one weeknight evening in July and lasted about ninety minutes.

The TRC team has edited owner comments slightly for clarity and to ensure anonymity.

4.7.3. ZNE-type Home Description

Homes in community A (represented by three owners) include several energy efficiency features. These included tankless gas-powered hot water heaters, energy efficient windows, high efficiency furnaces (90+ AFUE), SmartVent automatic night cooling ventilation systems, energy efficient lighting, upgraded insulation, and other energy saving features. Each home has a 2.4 kW roof-mounted PV system that is integrated into the roof with PV tiles, to present a seamless appearance. Owners had the option to customize some features of their homes and chose from a selection of layouts, which also provided variation. Homes built in this development range from 2,168 to 2,755 square feet and have three to five bedrooms.

This collection of homes was the first set of homes built by this builder to offer PV as a standard feature. The builder promoted the homes by operating a demonstration model home with a garage workshop where people could view the energy saving features included in the home. Customers could see the energy efficient lighting, soy based insulation products, and demonstrations of other options for saving energy. The builder included the price of the PV and other energy upgrades in the cost of the home as well as including five years of free performance monitoring and a warranty covering parts, workmanship, and repairs.

The homes in Community B (represented by one owner) had various energy efficiency features, and were projected to exceed Title 24 by approximately 40% (based on information obtained on-line). These homes also had PV.

4.7.4. Owners' Initial Awareness of the Near ZNE Homes

Participating owners learned about these ZNE-type homes in different ways during their home buying process. Three of the forum participants indicated that they were looking for a new home, but not specifically seeking a ZNE-type home. The fourth was not actively looking for a home, but was so impressed with the home, including its energy features, which his family decided to buy the home and move.

Two of the forum participants learned about the ZNE-type housing option by seeing the demonstration house for the ZNE-type development, one heard about it from a realtor, and the fourth learned about the ZNE-type features after purchasing the home. While searching for a new home, three of the four owners received more information about the home from representatives associated with the specific builder and sales staff in the targeted neighborhood. The fourth owner purchased a lot and had a home built based on the builder's description, which included PV, without knowing anything about PV.

Comments from owners about their home search and selection included:

- ◆ "We were not looking for a solar home. We just saw the house in the good neighborhood and the 'wow' factor came after we heard about the solar panels and what they give you."
- ◆ "We did not know anyone in the area and the real estate was very expensive. Our realtor mentioned that he knew a home that was new construction and in our price range. He mentioned to us that the home had solar."
- ◆ "I was honestly not looking to move, but some friends came to visit and you could see from my yard all the new construction. My friends said we should just go look. We looked at every homebuilder [in the area], and we toured the single story home and liked the layout. They had given us a brochure that said they had a house with all the energy efficiency features so we checked it out."
- ◆ "We were out looking at houses and saw the sign for solar homes so we came in and walked through the single story home. That was the thing we were really looking for: a single story with the layout we wanted."

Forum participants relied on several building professionals in their decision-making process. Realtors provided information about comparable homes and helped facilitate the purchase process. Builders provided detailed information about the features of available homes. The model home and its staff provided the owners with a hands-on demonstration of energy features and a visual understanding of energy saving measures.

4.7.5. Purchasing Motivations

The owners in the forum were initially seeking homes that fit their price range and met other criteria, such as location (including quality of local schools and proximity to work) and layout. One participant commented: "This house had the layout that we wanted. [My spouse] liked that it was solar and I just wanted the home buying process to be done. I was happy we could agree on a home. The location and the utility costs were a big factor."

Two of the four participants identified the reduced energy costs as a major motivator for purchasing their homes. One participant commented: “[The people selling the homes] told me that with the reduced bills from the solar, I could afford a slightly higher house payment because it would be offset. That made sense to me.”

For the other two participants, factors not related to energy, such as location of the home and home layout, were more influential; these owners perceived the energy features as an added bonus.

4.7.6. Feedback on Energy Features

Forum participants had differing levels of awareness about the energy saving features of their homes. Prior to purchasing the house, most participants indicated that they knew little about the energy features in the homes they were buying. As part of the purchasing process, the owners received information from their builders about the features in their home and how to operate them. Two of the four owners also received information during their tour of the demonstration house. One participant cited the demonstration home as the most influential source of information and explained: “[The demonstration] showed the thickness of the insulation. I could see what they were installing compared to other builders. I could see how much I would be saving. The physical demonstration was very influential.”

Prior to living in their ZNE-type homes, none of the forum participants had lived in a home with PV or special energy efficiency features. The forum moderator asked participants to list the other efficiency features present in their home. Participants appeared aware of many of the energy efficiency features of their homes and mentioned the soy-based insulation, double-paned windows, tankless water heaters, radiant barrier, and other energy efficiency features. However, participants were less inclined to discuss these features compared to their PV systems.

Participants had several positive comments about several energy efficiency features of their homes, and a few negative comments. They indicated that the soy-based insulation reduced outside noise, and that the radiant barrier in the attic keeps the temperature stable and comfortable. One noted, “The radiant barrier in the attic keeps the hot or cold in the house. What is inside the house stays inside the house.”

However, several participants reported that the radiant barrier reduced their cellphone reception and required them to purchase special equipment to use their phones. Participants also reported using their enhanced ventilation system (which draws in air from the outdoors to heat or cool the home if outdoor temperatures are in the right range) to cool their home in the morning and to control airflow into their home. One participant reported, “We use the [enhanced ventilation system] a lot. If the outside air is cooler, we will pull in air. That air is also filtered. This can really save a lot of energy because in Sacramento the air is cool at night.” However, another forum participant noted, “Some days the air is smelly around here. So I will check the air before turning it on.”

4.7.7. Feedback on PV

Three of the four participants indicated that the PV was very appealing when they were considering various homes. These three participants (all in Community A) owned homes with integrated solar systems (i.e., the PV is integrated into the roof). The fourth participant (from Community B), whose PV system is a more traditional external system, indicated that the PV was more of an afterthought in his family’s purchase decision.

After purchasing their homes, all of the discussion participants came to appreciate their PV and reported that they proudly describe them to others. Participants often referred to their homes as “solar homes”.

Of all the included energy features these forum participants discussed, PV was the most commonly and enthusiastically mentioned. Participants offered positive comments about PV, including the financial savings potential. One participant noted, “If given the option between a house with solar and without, especially the integrated solar that looks better, I would choose the solar house.”

All discussion forum participants reported having issues with the inverters that were installed with their PV systems. In three of the four cases, the builder quickly resolved these issues. For the fourth participant, the inverter replacement was a significant additional cost not included in their warranty and this forum participant perceived this cost to be a serious annoyance.

Forum participants viewed equipment warranties and part replacement packages as important parts of the PV value proposition. Three of them reported not worrying about the potential cost of parts or maintenance, because their long-term warranties covers them.

4.7.7.1. In-home Display

All participants reported having a display that provides them with information about the energy production of their PV systems. Participants described their systems as 2.4 or 2.6 kW systems. Participants frequently checked their displays, typically when coming and going through the garage, where the displays are located. One of the participants had connected the monitoring system to an online interface allowing them to monitor their production and use from a computer. All of the participants were aware of their system’s typical output in terms of kW, and enthusiastically compared these numbers with other forum participants.

4.7.7.2. Purchasing versus Leasing PV

The forum moderator asked owners why they decided to purchase homes with PV rather than purchasing a standard home and leasing PV. Three of the four participants indicated that they preferred to purchase the panels as part of their home purchase. Participants commented:

- ◆ “I have talked to others about it, and they don’t want to lease, because if you lease, you don’t own it. Often, people move within five to ten years, and if the system is leased, the person who buys your house has to qualify for that lease. It is not like a car where you can lease it and turn it back in—I am not sure people understand that.”
- ◆ “A better way to do it might be to purchase a home, and then use a separate energy upgrade loan to pay for the solar.”

Others indicated that the physical appearance of the panels could be a barrier, and they appreciated their homes’ roof-integrated PV. However, one of the four participants commented that leasing panels might be a better option because it would reduce the concern over replacement part costs and maintenance. This participant explained: “I would prefer to lease it first, and if I like it, I will buy it. To replace parts is expensive. If you get a 20-year lease, they will fix anything that goes wrong with it. Now the one I have, replacing or fixing anything is very expensive.”

4.7.8. LEED Certification

All three of the participants in Community A reported learning at the time of purchase that their homes met LEED program standards and receiving LEED plaques for their homes. All three of these participants indicated that they believed that the LEED certification carried some weight. One reported, “We had our LEED certification displayed before the kids’ photos went up.” The second reported, “I keep my LEED plaque in my office in case I want to give it to the realtor. I can tell them ‘This is a LEED certified home

when none of the other ones in the area are”’. The third described the builder as a leader, because the homes were LEED certified.

Community B was not a LEED certified community (based on an internet search), and the owner from this community did not mention that his home had received any labels.

4.7.9. Living Experience and Satisfaction

Participants reported that the experience of living in a ZNE-type home is positive and provides an improved quality of life compared to their previous homes. All of the participants reported being satisfied with how comfortable and quiet their homes are, explaining that these ZNE-type homes offer more comfort and are quieter than their previous homes due to the high levels of insulation and upgraded windows.

Participants also indicated that they had made no changes to their lifestyle when they moved to their new ZNE-type home, but now had lower energy costs. Increased energy efficiency of their homes allowed them to live comfortably without fear of high bills, feelings of guilt over their energy consumption, or criticism from other family members about their heating/cooling choices. They also reported that their PV systems generated as much energy as they expected and that they were satisfied with the resulting reduction in their utility bills.

- ◆ “I was pretty impressed when I started getting my net metering bill. My bill is less than \$1000 a year and I keep my house at 73 or 74 degrees all year round.”
- ◆ “My energy bill is less for my 2,400 square foot home than it was for my 700 square foot apartment.”

One participant indicated that, if given the choice, they would like more feedback from the home and ability to understand how well the home is functioning. Another participant reported being dissatisfied that the homes do not include any water recycling or water-saving irrigation features.

4.7.10. Home Value

The forum moderator asked group participants about the value of their ZNE-type homes. Only one of the participants indicated having had their home appraised, but all of the participants actively tracked the values of other similar homes in the area. All of the group participants indicated that they are confident that their home is worth more than a similar home without the energy features. Participants also stated that their homes would likely sell much faster than a similar home without the additional features. One participant commented about a home with PV compared to code-built homes: “I bought the home with solar for resale value. It should sell faster. I noticed nearby homes with solar sell quickly.”

Participants indicated that, if they were to move again, they would place a high value on the energy efficiency of their potential future home and would be interested in homes with PV. Only one of the four indicated that PV would be a low priority on their list of priorities, but this participant would consider leasing a PV system for a home that did not have one.

4.7.11. Familiarity with ZNE

All of the forum participants reported being familiar with the term “zero net energy”. However, none of them connected the term to their home or had heard the term mentioned in connection with their homes.

4.8. Surveys with Energy Efficient owners

This appendix provides findings from surveys with 112 owners living in Energy Efficient homes. The homes represented in this survey meet the entry-level for requirements for CAHP participation (i.e., 15-20% more efficient than Title 24), but are not so efficient as to be considered ZNE-type homes. Approximately one-third (30%) of the homes represented in the survey have PV. The vast majority (109) were production homes.

4.8.1. Description of the Sample

4.8.1.1. Sampling

The TRC team used the CAHP databases to develop a sample of Energy Efficient homes. PG&E, SCE, and SoCalGas provided their CAHP databases. (SDG&E initiated new customer privacy policies at the start of the study and was not able to provide its CAHP database for the owner surveys.)

The TRC team defined Energy Efficient homes as those between 15% and 20% more efficient than Title 24. Because some of the databases included homes dating back to 2006, and the databases were provided by July 2014, this performance generally represented a mix of homes built between 15-20% above the 2005 Title 24 and the 2008 Title 24. The TRC identified the entire population of PG&E and SoCalGas homes that met these energy performance criteria, because these populations were approximately equal to the number of homes needed for the survey. For SCE, the number of homes that met these energy criteria exceeded the number needed for the survey; consequently, the TRC team identified a random sample of homes. The TRC team removed duplicates between SoCalGas and the other IOUs. The TRC team then sent this list of addresses to the IOUs, and the IOUs provided owner names and contact information for these homes.

After removing records without contact information, 1,367 owners remained. Of these, 1,354 were production owners and 13 were custom owners. The TRC team targeted 80-136 total surveys, of which at least ten were targeted to be with custom owners. Because of the small number of custom owners, the TRC team included all 13 custom homes in the survey. The TRC team took a random sample of the production home purchasers for initial survey contacts, and kept the remaining owners as additional sample points, for use if the survey completion rate was lower than expected.

The TRC team conducted surveys between July 31 and August 15, 2014, and the surveys took an average of 16.5 minutes to complete. The TRC team completed surveys with 112 owners, with surveys split roughly in half between Northern and Southern California owners. Figure 19 presents the number of completed surveys by home type and location.

Type of home	Northern CA	Southern CA	Total
Production	53	55	108
Custom	4	--	4
Total	57	55	112

Figure 19. Description of Homes Represented in Energy Efficient Owner Survey

Throughout this chapter, the TRC team identifies any statistically significant differences between responses from Northern and Southern California Energy Efficient owners, as well as those owners with and without PV systems.

4.8.1.2. Home and Owner Characteristics

Energy efficient homes had about four bedrooms and three occupants, on average. Owners in Southern California had slightly larger homes than those in Northern California (ANOVA at $p < 0.05$).

Region	House Size (# of Bedrooms)		Household Size (# of People Living in the Home)	
	Count	Average	Count ⁶²	Average
Northern CA	57	3.4	56	3.0
Southern CA	54	4.0	54	3.3
Statewide	111	3:7	110	3:1

Figure 20: Home and Household Size for Energy Efficient owners in Surveys

Nearly all (91%) Energy Efficient owners reported being the first owners and occupants of their home. However, these responses may be in part because the survey targeted homes constructed in 2006 or later. Less than half (40%) of owners reported being first time owners; with owners in Southern California being more likely to identify as a first time owner than those in Northern California (56% and 25%, respectively).

4.8.2. Reasons for Purchase

The TRC team asked owners which home features were critically important in their decision to buy their home, and which of these considerations were the most important in their decision. The TRC team presented these questions in an open-ended format. Figure 21 and Figure 22 present the results.

⁶² Three refusal responses excluded from analysis.

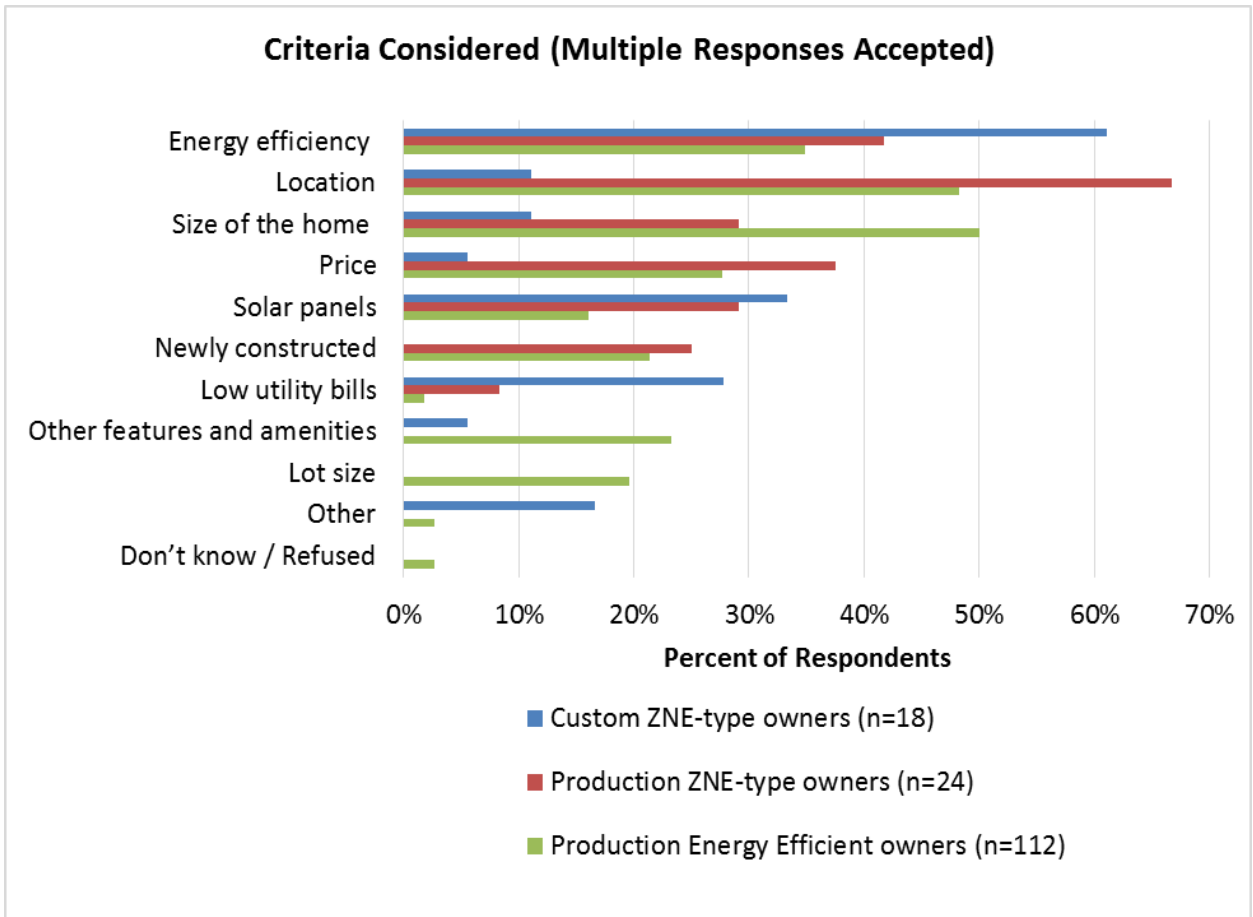


Figure 21. Home Purchasing Criteria for Owners of Different Home Types

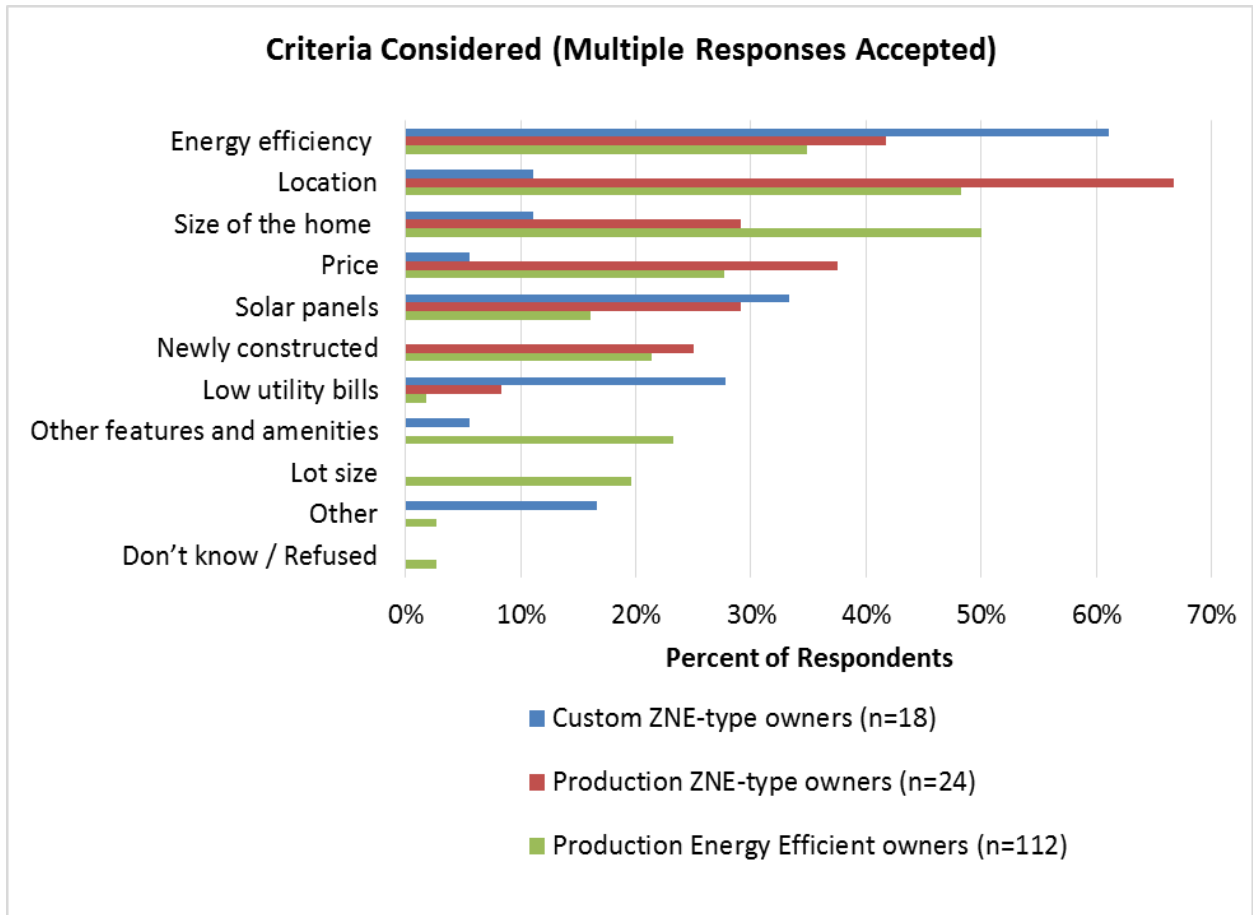


Figure 22. Most Important Home Purchasing Criteria Reported by Owners of Different Home Types

Home size (50%), location of the home (48%), and energy efficiency (38%) were the top three considerations for owners when purchasing their home (Table 10). Taking all energy features together (energy efficiency, PV, and low utility bills), these features totaled 53%. However, when asked what the “most important” feature in their purchasing decision, owners cited the size (23%) and location (23%) of the home rather than energy related features (16% for energy efficiency, PV, and low utility bills combined).

The TRC team also analyzed these responses based on whether the owner reported that this was their first home. First-time owners were more likely to report energy related measures as the most important feature in their purchasing decision than previous owners (29% and 8%, respectively). This difference was statistically significant (Z-Test of Proportions at $p < 0.05$).

4.8.3. Energy Messaging of the Home during Purchase

Nearly all owners (87%) reported being aware their home was built to be more energy efficient than a typical home at the time of purchase. When the surveyor provided a list of seven common energy efficiency programs and descriptions, owners most commonly recall the use of “energy efficient house” and “ENERGY STAR certified home” to describe the efficiency of their home, as shown in the table below. Northern California owners were more likely to report the use of “energy efficient house” or “solar home” to describe their homes’ efficiency than those in Southern California. Almost none were familiar with the CAHP program, even though all owners in the survey had purchased a CAHP home. However, the TRC team notes that CAHP is generally a midstream program; the utilities typically provide

incentives to the builder, not the owner. The few owners that reported their homes were described, as CAHP homes were mostly located in Northern California.

When asked what the most important description was in their purchasing decision, over half of owners reported the description of “energy efficient” was most important (58%), followed by the description “solar home” (45%), followed by an “ENERGY STAR certified home” (29%). As described in the table footnote, when calculating the percent that reported a description or label was most important, the TRC team only considered the owners that reported their home was described in this way.

Not all homes reflected in the survey were ENERGY STAR Home, GreenPoint Rated, or LEED certified, and the TRC team did not have the data to determine which homes in the survey had these labels. Consequently, the TRC team cautions readers when interpreting the awareness responses for these labels. However, as shown in the last column of Figure 23, the owners that reported their homes received a label (e.g., ENERGY STAR, GreenPoint Rated, LEED, and CAHP) generally did not identify this label as the most important description to influence their purchasing decision.

Description of Energy Performance or Label	Number and Percent Reporting their Home was Described this Way at Time of Purchase						Reporting Most Important Description (n=108) ⁶³	
	Northern (n=57)		Southern (n=55)		Total (n=112)		Count	Percent ⁶⁴
	Count	Percent	Count	Percent	Count	Percent		
Energy efficient house ⁶⁵	51	90%	42	76%	93	83%	54	58%
Solar home ^{66, 67}	16	90%	6	67%	22	81%	10	45%
ENERGY STAR Home	31	54%	32	58%	63	56%	18	29%
GreenPoint Rated	8	14%	9	16%	17	15%	0	0%
LEED certified house	7	12%	5	9%	12	11%	1	8%
CAHP house	7	12%	1	2%	8	7%	2	25%
Sustainable house	5	9%	5	9%	10	9%	0	0%
None	4	7%	11	20%	15	13%	N/A	N/A

Figure 23. Energy Messaging Used During Purchase, by Region (Multiple Responses Allowed)

When asked if the energy efficiency of their home was described in any other way, thirteen owners provide additional descriptions which included better insulation (eight mentions), efficient windows (six

⁶³ The TRC team excluded three “don’t know” and one “refused” response.

⁶⁴ When calculating the percent reporting this as the most important description, the TRC team used the number of owners that reported their homes were described this way as the denominator. For example, of the 93 owners that reported their home was described as energy efficient, 58% identified this as the most important description. Because the number of respondents reporting some descriptions (e.g., CAHP, LEED) is low, these percentages should be interpreted with caution.

⁶⁵ Responses significantly different between Northern and Southern California respondents (Z-Test of Proportions at p<0.05).

⁶⁶ Responses significantly different between Northern and Southern California respondents (Z-Test of Proportions at p<0.05).

⁶⁷ Only includes owners who reported their home came with PV installed (Northern California, n=18; Southern California, n=9; Total n=27).

mentions), efficient appliances (three mentions), efficient roofing (three mentions), and efficient HVAC (two mentions).

The TRC team also asked owners with PV systems how often they use the term “solar home” when describing their home to others. About three-quarters (25 of 33) of owners reported they “sometimes” or “often” use the term “solar home” when describing their home to others.

4.8.4. Exposure to Energy Rating Scores during Purchase

Less than one-quarter (23%) of owners reported receiving an energy rating or score, or a description of their homes expected energy performance during purchase. Northern California owners were more likely to report receiving an energy score than owners in Southern California (30% compared to 16%, respectively). Over one-third of owners (39%) reported they did not know if they received an energy rating, score, or description. As shown in the table below, among the 26 that received this information, most (16 of 26) owners reported receiving the information during the initial marketing of the home.

Response	Count	Percent
Received during the initial marketing of the home	16	62%
Requested information	4	15%
Received after moving in	4	15%
Did not recall	2	8%
Total	26	100%

Figure 24. When Owner Received Energy Rating, Score, or Description

When asked what energy rating, score, or description they received, about three-quarters (18 of 26) of owners reported they did not remember. For those owners that did recall what information they received, the Home Energy Rating System (HERS) Index was mentioned by five owners (all of whom were located in Northern California), followed by GreenPoint Rating, ENERGY STAR, and a “letter related to energy efficiency” (one mention each). For those that received information on their home’s energy performance, over three-quarters (18 of 26) reported the information they received was very useful (at least a rating of four on a five-point scale).

4.8.5. Natural Gas Appliance Selection

About two-thirds (61%) of Energy Efficient owners reported they had at least some ability to customize or choose specific features for their home prior to moving in. Of those who did, about two-fifths (26 to 68) of owners reported they had the option to select a natural gas appliance over an electric appliance, as shown in the table below. The majority of owners who had a fuel option selected a natural gas appliance over an electric one. The majority of owners who reported that they did not have a fuel choice reported that natural gas appliances were already installed.

Response	Number (%)				Summary for all appliances
	Stove	Furnace	Clothes Dryer	Water heater	
Had natural gas option	16 (24%)	12 (18%)	21 (31%)	10 (15%)	26 (38%) had a natural gas option for at least one appliance
<i>Chose natural gas option</i>	15 of 16 (94%)	10 of 12 (83%)	15 of 21 (71%)	9 of 10 (90%)	23 of 26 (88%) chose natural gas for at least one appliance
No fuel option	51 (75%)	52 (76%)	42 (62%)	51 (75%)	Not applicable
<i>Electric appliance already installed</i>	1 of 51 (2%)	4 of 52 (8%)	7 of 42 (17%)	3 of 51 (6%)	13 of 59 (22%) had at least one electric appliance already installed
<i>Gas appliance already installed</i>	50 of 51 (98%)	48 of 52 (92%)	35 of 42 (83%)	48 of 51 (94%)	54 of 59 (92%) had at least one natural gas appliance already installed
Don't know (didn't remember)	1 (1%)	4 (6%)	5 (7%)	7 (10%)	Not applicable

Figure 25. Availability and Selection of Natural Gas Appliances (n=68; Multiple Responses Allowed)

For the owners who reported selecting an electric appliance over a gas appliance, the TRC team asked them why they did not choose a gas appliance. Reasons for selecting electric clothes dryer included that natural gas options were more expensive, safety concerns with gas, familiarity with electric appliances, and already owning the appliance prior to moving in (one mention each). The one owner who selected an electric stove over a gas stove reported doing so because of safety issues. Owners who selected electric water heaters over gas could not articulate why they made that decision.

4.8.6. Feedback on PV

About one-third (30%) of owners reported that their home is equipped with PV, with owners in Northern California more likely to report having PV than those in Southern California (37% compared to 22%, respectively). Among owners with PV, most (28 of 33) reported that it was included with the home. The TRC team asked owners that responded they did not have a PV whether they considered this features. About one-quarter (25 of 81) reported they did consider PV when they purchased their home. The majority of these 25 respondents reported that their PV options were to own the PV system (13 mentions), followed by leasing the PV system (five mentions). Only one owner reported having the option for a Power Purchase Agreement (PPA). Eight owners reported not knowing what PV options were available when they purchased their home.

As shown in the table below, when asked why they did not install PV on their home, owners most commonly cited that PV was not an option (40%) or that the cost was prohibitive (31%).

Among those owners indicating that PV was not a consideration, almost all (16 of 17) were Southern California owners.

Response	Count	Percent
Not an available option	32	40%
Cost	25	31%
Not a consideration	14	17%
Not enough information / knowledge barrier	7	9%
Don't use enough electricity / have low bills	6	7%
Concerns about Return on Investment	5	6%
Didn't like the appearance	3	4%
Technological concerns	2	3%
Did not want long term lease	1	1%

Figure 26. Reasons for Not Installing PV (n=81; Multiple Response Allowed)

4.8.7. Expectation of and Experience Living in an Energy Efficient Home

4.8.7.1. Expectations

As shown in the table below, owners most commonly reported expecting lower energy bills (62%) or a more comfortable home (20%) from their Energy Efficient home. Nearly all (99%) owners reported that their expectations “have been met” or have been “somewhat met.” The one owner whose home had not meet their expectations reported expecting lower energy bills.

Expectation	Count	Percent
Lower energy bills	69	62%
Comfortable home	22	20%
Uses less energy/energy efficient	5	4%
Good for environment	4	4%
Other ⁶⁸	6	5%
No expectations/Don't know	18	16%

Figure 27. Expectations for Living in an Energy Efficient Home (n=112; Multiple Responses Allowed)

4.8.7.2. Concerns with Energy Efficiency Features

Owners were asked, “When building [custom home] / When choosing [production home] your home, please let me know if you were “not at all,” “somewhat” or “highly concerned” about each of the following, because of the energy efficient features of your home?” As shown in the figure below, over half of Energy Efficient owners reported being at least somewhat concerned with initial cost, the resale value of their home, and efficiency features. Slightly less than half were at least somewhat concerned about sufficient ventilation, and almost one-third were at least somewhat concerned about the ability to manage high tech features. Owners who reported having PV installed on their home at the time of

⁶⁸ Other responses included “everything will work because the home is new” (two mentions), “can use A/C freely,” “good investment,” “good ventilation,” and “zero energy consumption” (one mention each).

purchase were significantly more likely to report being concerned with managing high tech features than those who did not have PV installed (46% and 26%, respectively; Z-Test of Proportions at $p < 0.05$). Few owners reported being concerned with the comfort of their home.

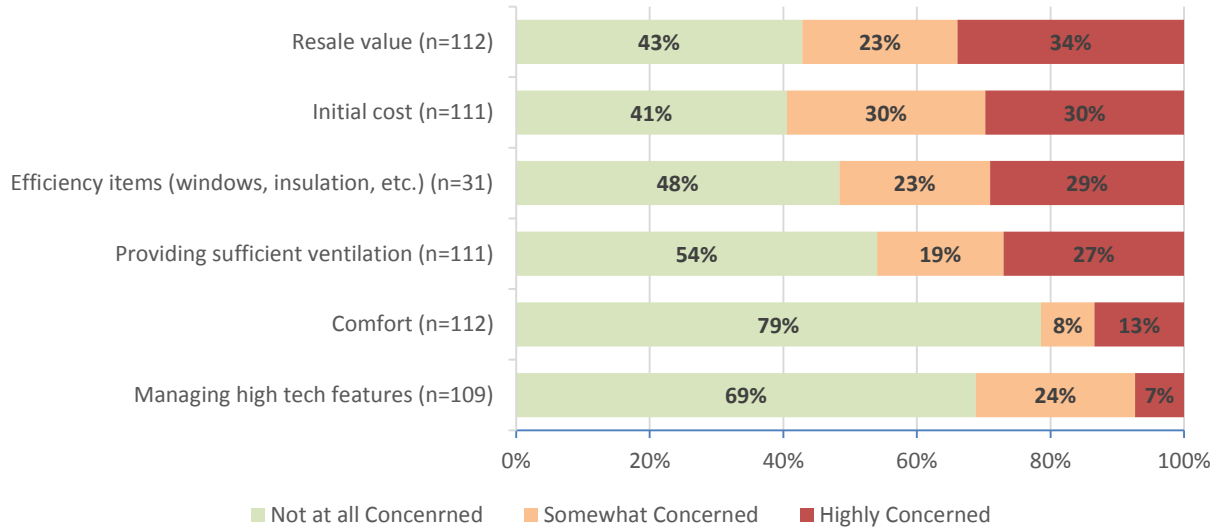


Figure 28. Owner Concern with Energy Efficient Home Features⁶⁹

4.8.8. Owner Awareness and Interpretation of ZNE

Less than one-third (28%) of these owners surveyed reported being familiar with the term “Zero Net Energy”. As shown in the table below, when asked what ZNE meant to them, owners most commonly mentioned that a ZNE home is one that produces as much energy as the home uses.

⁶⁹ The TRC team excluded “don’t know,” “refused,” and “not applicable” responses.

Response	Count	Percent
Producing as much or more energy as the home uses	13	42%
No energy bills	6	19%
Minimal energy use or “saving energy in every way”	5	16%
Not consuming energy for their home from the utility	3	10%
Sell back energy to utility	2	6%
Other	4	13%
Don’t know (i.e., had heard of ZNE, but didn’t know what it meant)	1	3%

Figure 29. Energy Efficient Owners: Interpretation of ZNE (n=31; Multiple Responses Allowed)⁷⁰

The TRC team provided a definition of ZNE⁷¹ to owners unfamiliar with the concept. After receiving the definition, an additional 18 owners reported hearing about ZNE homes; bringing the total of owners aware of ZNE to 49 (or 44%). When asked how they learned about ZNE, owners most commonly reported word-of-mouth sources (20%), media (20%), or a builder (14%; Table 24).

Source	Count	Percent
Word-of-mouth (Friend, family, acquaintance)	10	20%
Media (Magazine, newspaper, TV)	10	20%
Builder	7	14%
Internet	5	10%
Showcase home, realtor	4	8%
Solar contractor	4	8%
Utility company/ contact	3	6%
Other	3	6%
Don’t know or unclear response	8	16%

Figure 30. Sources of Information about ZNE (n=49; Multiple Responses Allowed)

4.8.9. Owners’ Valuation of Energy Efficient Homes

Two-thirds (66%) of owners expect their homes’ energy features will result in a higher sale price, with the remaining reporting their home would sell for about the same amount as a code-built home in the same location and the same size. Comparing owners with PV and those without, the TRC team found

⁷⁰ Other responses included “ability to set what you use with what you generate,” “distinct look and design of home,” “appliances, lighting, construction materials, windows are more energy efficient and keep the heat and cool in,” and “solar powered” (one mention each).

⁷¹ The definition the TRC team provided to owners: “Zero net energy means that a home generates as much energy as it consumes in a year. The “zero net” refers to the notion that the amount of energy generated at home, minus the amount of energy consumed, is approximately zero.”

owners with PV were more likely to report their home would sell for more compared to those without PV (91% compared to 59%, respectively).

When asked how much of a priority they would put on purchasing a ZNE-type home in the future, about half (49%) of owners reported that having an Energy Efficient home would be a “high priority”. Again, those owners with PV were significantly more likely to report placing a high priority on a high energy-performance home than those who did not have PV (70% compared to 42%, respectively).

Response	With PV		Without PV		Total	
	Count	Percent	Count	Percent	Count	Percent
No priority	1	3%	2	3%	3	3%
Low	0	0%	8	11%	8	7%
Medium	9	27%	34	45%	43	39%
High Priority	23	70%	32	42%	55	50%
Total	33	100%	76	100%	109	100%

Figure 31. Priority of Purchasing a High Energy-Performance Home in the Future, by PV System Presence⁷²

After explaining the concept of ZNE, the TRC team asked these Energy Efficient owners the following question:

- ◆ If you were to buy another home to live in, how much of a priority would you place on buying a high energy-performance home like a zero net energy home, assuming it is in the right location?

Based on responses, 55 (49%) and 43 (38%) indicated they would put a high and medium priority, respectively, on purchasing a ZNE-type home.

The TRC team then asked:

- ◆ If your home were for sale, do you think the energy features would cause it to sell for “more”, “less,” or “about the same” as a home in about the same location and of the same size, but with typical energy performance? In terms of a percentage, about how much (more / less)? (open-ended question)
- ◆ In terms of a percentage, how much more would you be willing to spend up front on your next home for it to be zero net energy or high-energy performance, compared to a home of the same size and in the same location with typical energy performance? (coded responses: 0%, 1-5%, 6-10%, 11-15%, 16-20%, 21-30%, more than 30%)

The TRC team provides the responses to these questions in the figure below. The y-axis presents the respondent’s expected incremental sales price, because the home is Energy Efficient. The x-axis presents the respondent’s reported willingness-to-pay for a ZNE-type home. Note that the type of home described in these questions was different. The expected increase in sales price question specified an Energy Efficient home, while the willingness-to-pay question specified a ZNE-type home. Also, note that the question on sales price was open-ended (resulting in a variety of values in the y-direction), while the

⁷² Responses significantly different between owners with PV and those without PV (Z-Test of Proportions at p<0.05)

willingness-to-pay question provided multiple-choice options (resulting in only six responses in the x-direction).

One-third (33%) of Energy Efficient owners reported the energy efficiency features of their home would increase the value of their home by 1% to 10%, with an average of 14% and median of 10%. Half (50%) of the Energy Efficient owners reported they would be willing to pay 1% to 10% more to obtain a ZNE-type home. In addition, the figure below shows that there is a positive, linear relationship between owners' perceived value of energy efficiency features in their home and their willingness-to-pay for a ZNE-type home. In other words, the more value owners attribute to their home's energy efficiency features, the more they are willing to pay for a ZNE-type home.

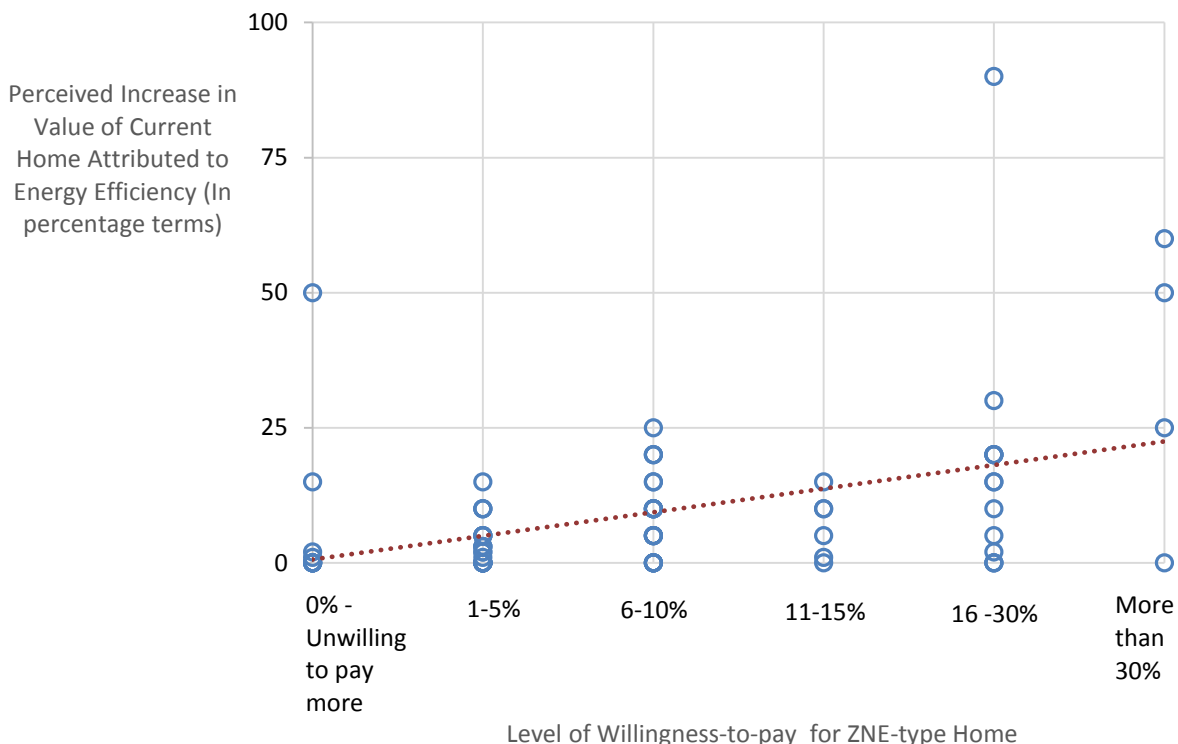


Figure 32. Owners' Perceived Increase in Home Value for their Energy Efficient Home Compared to Their Willingness-to-pay for a ZNE-type Home (n=112)

4.9. Forum with Code-built Owners

The TRC team conducted an owner discussion forum with ten Code-built owners. This forum sought to understand owner home selection, purchasing motivations, and overall experience with their homes. This forum was designed to parallel with the ZNE-type owner discussion forum, which covered similar topics with ZNE-type owners. The owners that participated in the code-built owner forum lived in a community near Sacramento, CA, and this community was the same broader development that included Community A in the ZNE-type owner forum.

4.9.1. Research Objectives

The TRC team added this data collection to the project to provide another perspective from owners who chose not to purchase a ZNE-type home. The TRC team identified the following research objectives to be addressed by this research.

RESEARCH OBJECTIVES

Why do homebuyers choose code-built (instead of energy efficient or ZNE-type) homes?

What do Code-built owners know about ZNE? Are they aware of ZNE? Do they find the concept appealing?

What value do Code-built owners place on saving energy or energy saving features for their home? What actions have they taken to adapt their homes to be more Energy Efficient?

Figure 33. Code-built Forum Research Objectives

4.9.2. Forum Recruitment Method

The TRC team recruited forum participants by sending an email to the owners association. The email summarized the purpose of the forum, offered a cash incentive for participation, and asked interested owners to complete a brief survey that gathered information about the energy features of the home they purchased and their interest in energy efficiency and PV at the time of home purchase. The team received approximately 25 responses to the survey and chose 12 to attend the forum. The TRC team identified these 12 owners by excluding owners from the ZNE-type homes in Community A⁷³, and by prioritizing those that did not have PV (because this was intended to be a Code-built forum). Of these owners, ten attended the forum (i.e., two did not show up).

The forum lasted about ninety minutes. Owners in the forum had lived in their homes for between three and eight years. Of the ten participants, two had installed PV systems on their homes after purchase.

The TRC team edited owner comments slightly for clarity and to ensure anonymity.

4.9.3. Purchasing Motivations

Similar to owners in the ZNE-type forum, the owners in the Code-built forum sought homes within their price range, in a desirable location (i.e., close to high quality schools and work), and with a floor plan they liked. Participants recalled that the sales staff at the housing development emphasized the quality of the local schools, availability of a community center with pool, and proximity to the city. The majority of participants also identified the family-friendly atmosphere of their housing development as an appeal. Most of the forum participants purchased new homes, but a minority moved into pre-owned homes in the target community. Participant comments about home selection included:

- ◆ “Our first priority was the schools and the family friendliness. We fell in love with the area and have never looked back.”
- ◆ “We bought our home, because it had lots of natural light and an interior courtyard. That was important and appealing.”

⁷³ The TRC team identified owners in the near ZNE Community A based on street and builder name, which owners provided in the survey.

- ◆ “We were really looking for a one-story home and they did not have a model of one. But we wanted one enough to take the chance and buy one without seeing a model.”
- ◆ “When it comes down to it, it’s worth it for us [to live here] even though we do not have solar, because of the schools and the lifestyle. You just compensate.”
- ◆ “We fell in love with the area and figured we would deal with the bills later.”

Several forum participants indicated that they considered energy efficiency when looking to purchase a home, but that it was a lower priority than the location or family friendly atmosphere. One forum participant purchased a home with PV integrated into the roof. A few other participants indicated that they looked for a home with PV, but did not find one with the floor plan they wanted.

The TRC team asked participants if they had considered natural-gas fired equipment or appliances that were more efficient during their home purchase process, such as a high efficiency furnace. Forum participants indicated that they had not considered natural gas efficiency measures, because natural gas is relatively inexpensive and often used for heating, which is a small expense in their climate.

4.9.4. Familiarity with ZNE and Initial Feedback on the ZNE Concept

The forum moderator asked participants if they had heard of the term Net Zero Energy, and none reported any familiarity with the term. After the moderator offered a definition, all of the forum participants indicated that they found the ZNE concept appealing, as long as the cost is reasonable. One participant commented that an increased focus on ZNE would require a code change to make the features and pricing standard. Comments from these forum participants included:

- ◆ “That sounds like the future.”
- ◆ “It sounds great, but it depends on the cost.”
- ◆ “It sounds expensive, like something someone would try to sell you door-to-door. How much would it cost versus how much you would save?”
- ◆ “It would depend how much it would cost to add it to your house.”

Forum participants had many questions about ZNE beyond cost. These questions included how water conservation is integrated, the specific technologies involved, and how a change in standard would influence existing homes.

The TRC team asked participants their thoughts about a future where ZNE-type homes with PV are the only options for new homes. Participant comment included:

- ◆ “If they made something like that mandatory, they would have to provide an incentive. There would need to be an initial subsidy.”
- ◆ “It would have to be something they require for everyone, like how there are sprinklers in all new homes.”
- ◆ “If they did that on a large scale, it would reduce the cost of doing it.”

4.9.5. Awareness and Choice of Energy Features

4.9.5.1. Energy Efficiency Features

When asked about energy efficiency features, forum participants recalled that staff from the development told them about efficient windows, low-flush toilets, and efficient appliances. Several

homebuilders build houses in the same development, and each builder offers a different package of features. Participant comments included:

- ◆ “[Our builder] sold us on the energy efficiency pretty well. They told us about the windows and the appliances.”
- ◆ “We liked the fact that our house had energy efficient features, and we know in this area we have higher energy costs. In the end, we decided to add solar to reduce our bills.”

Only one of the participants spent time researching additional energy efficiency features which could be requested during construction. This participant paid extra to have additional insulation blown-in and a two-stage heating and cooling system installed. These add-ons were not standard options from the builder, but available by special request. This participant recounted the experience:

- ◆ “When we decided on a builder, they were not pushing energy efficiency. When I was going through the list of options, I found that you could add blown-in insulation. I only found that out by looking through a list. I found out there were two-stage heating and cooling systems. But the builder was not offering them, so I had to ask. I had to go through the VP of the company to get these features. It seemed rather interesting that in an area that gets rather warm, they were not pushing energy efficiency better. I have saved about thirty percent on my bills with the changes by adding these features.”

No other forum participants reported being aware, at the time of purchase, about the potential to increase the efficiency of their home with optional add-on features. Several forum participants reported being dissatisfied with the energy performance of their homes and appliances, especially air conditioners. These participants commented that their appliances and equipment are not as efficient as they would expect for a newer home, and that they would consider replacing their current appliances with more efficient models when they fail. Comments about air conditioning equipment included:

- ◆ “I looked at the sticker on the side of the unit that says the level of efficiency, and it’s pretty darn low. With how large our house it, during the summer, that unit is working hard.”
- ◆ “I thought it was weird that [the builders] were trying to make it seem like it was such an energy efficient house, but then they put in this cheap air conditioner.”
- ◆ “You would think they would at least give you the option, if you wanted to, to upgrade to a more efficient unit.”

4.9.5.2. PV Considerations

Of the ten non-ZNE forum participants, two had PV systems on their home. One of these systems was installed when the home was built, while the other was installed post occupancy. The participant with PV installed at the point of purchase reported that the PV was not the most appealing feature of their home, but that it was a selling point when they were making their purchase decision. This participant described their PV as “nice, but not a must have”. The other participant with PV decided to install it after receiving high utility bills: “I liked the idea of having a solar home, but it was not a main thing I was looking for. Then, once I started getting my [utility] bills, it became a main thing I was looking for.”

The forum participants without PV explained that they had not found a home with PV in their price range or desired location while they were searching for a home. Energy efficiency was not a part of the sales information forum participants received when researching their future homes and, for most, PV was not a consideration. Participants offered the following comments about PV:

- ◆ “Energy was for us, or at least my wife, on our radar. We looked at homes that had solar and we liked that. But in the end, we fell in love with the floor plan at a different home. We were sad that we did not find one with solar. Now we have people at our door all the time trying to sell us solar.”
- ◆ “I do not understand why they did not build all the homes with solar. Most of the new ones seem to be coming with it integrated, but when I bought my home, I never even thought about energy efficiency. I thought that, since it’s a new home, it would automatically be energy efficient.”
- ◆ “I think that after the market took a hit, the builders started adding solar as an incentive for people to buy the new homes.”
- ◆ “When we were looking at the homes in this area, we were not offered solar, and we were shocked [when we got our first bills], because coming from the East Coast, the bills were almost ten times as high. We had just moved in and got the bill for only being in the house for ten days, and it was almost \$200.”

Several participants had heard from other people about positive or negative experiences with PV, but remained undecided on whether they would install PV on their homes. Comments included:

- ◆ “I have heard that when PG&E power is out, you aren’t allowed to keep your solar going, because that can feed energy back into the grid. What I would look at is if you can get a switch to allow you to isolate from the grid, so you can keep using your electricity.”
- ◆ “I would be concerned about selling my house. What if someone wanted to buy my house, but did not want to pay for the solar?”
- ◆ “I don’t know if I will be in my house long enough to make it cost effective for us, so we just deal with the higher bills.

4.9.5.3. Purchasing versus Leasing PV

Code-built forum participants reported that they are frequently contacted by companies offering leased PV systems. Most participants did not find leasing panels attractive, because they were skeptical of the energy savings or did not understand the leasing process. One stated, “If you’re not stuck in a lease, solar panels are a plus.”

4.9.5.4. Energy Efficiency Labels

None of the Code-built forum participants were familiar with energy labels or specifications. After the moderator described LEED, a few participants could recall seeing commercial or retail buildings with the labels. None of the participants considered home labels during their purchase process. One participant had received a rebate for having an ENERGY STAR appliance, but none appeared aware of the ENERGY STAR Homes label.

4.9.6. Living experience

Code-built forum participants indicated that they are generally satisfied with the experience of living in their homes. A few participants voiced small complaints about the layout, availability of natural lighting, or the orientation of their home. Code-built forum participants did not typically mention energy related topics without prompting when asked about overall home satisfaction. When asked specifically about comfort and energy use, participants indicated that their large homes require a great deal of energy for

heating and cooling, and temperature balancing issues (i.e., some rooms are more difficult to heat/cool than others). Comments included:

- ◆ “Our bills are upwards of \$400 in the winter. It’s outrageous.”
- ◆ “Our highest bill has been almost \$1,000 in July. But we do have a pool.”
- ◆ “I am trying to sell my house now. And if people ask me about what my bills are, they are no longer interested in the house.”
- ◆ “I see a lot of foreclosures in my neighborhood, and I think sometimes people bought a bigger house and did not realize how expensive it is to operate it.”

Participants indicated that they have learned how to set their thermostats to maximize comfort while minimizing their energy costs. Several participants recalled being shocked by their first energy bills in their homes and have since taken steps to reduce their energy consumption. These steps included installing PV systems, installing a patio cover to shade part of the home, adding screen doors for ventilation, installing energy efficient lighting, using a programmable thermostat, purchasing a solar pool heater⁷⁴, and unplugging electronics. Comments included:

- ◆ “We are very conservative. We try not to turn the AC on much. We use ceiling fans. We have a pool, so I often decide to just go swim.”
- ◆ “I do not turn on my AC until 12 or 1 o’clock.”
- ◆ “We looked for a two story home where the stories are not stacked directly above each other, so the heat does not travel as much into the upstairs. We also opted for no high ceilings and no large open foyer.”
- ◆ “We have looked into an attic fan, because it’s so much cheaper than solar, but we have not done it yet.”
- ◆ “I am very conscious of peak hours, and I signed up for the program for savings if you do not use energy during those times. I do my dishes late at night.”

4.9.7. Future Home Buying Priorities

When asked about their purchasing criteria relating to energy features for their next home purchase, several participants indicated that they will consider PV. Of the two participants who had already installed PV, one indicated that they would definitely purchase PV for their next home and would purchase a larger capacity system. Another participant with PV appreciated the dashboard feature included with their PV system, which allows them to view their energy consumption and production.

Participants also indicated that if they were to purchase another home, and their family situation allowed, they would look for a smaller home—possibly one story, and a home with energy efficiency measures (e.g., tankless water heater).

⁷⁴ Three of the ten participants owned private pools. One had installed a solar pool heater.

5. RESULTS OF ENERGY LABEL QUESTIONS

The TRC team asked ZNE-type owners and energy efficient homes how their homes were described to them, in terms of energy performance or energy labels. The TRC team then asked owners which of these descriptions or labels was most important in influencing their purchasing decision. However, as described below, the TRC team could not draw clear conclusions based on the data, so the team did not present this information in the body of the report.

Owners' responses are shown below. However, the TRC team did not have the databases for the various programs (e.g., ENERGY STAR Homes, LEED, GPR) to determine which owners had homes that had earned these labels, and compare these to the owners that reported their homes were described with these labels. This is indicated by the asterisk (*) in the table below. For example, 19% of ZNE-type owners reported that their homes were described as LEED Homes, but the TRC team does not know how many of these homes had actually earned the LEED label. Thus, it is difficult for the TRC team to draw conclusions regarding owner awareness of labels from this data, or whether builders were properly describing homes to owners.

Owner group	Described as an energy efficient home	Described as a solar home	Described as a CAHP home	Earned the ENERGY STAR Home label	Earned the LEED label	Earned the GPR label	Described as a Passive House
ZNE-type owners in interviews (n=42)	95%	66% (n=38)	23%*	50%*	19%*	14%*	14% ⁷⁵
Energy Efficient owners in surveys (n=112)	89%	82% (n=33)	10%	71%*	14%*	20%*	Did not ask

Figure 34. Owners' Responses to the question, How was your home described, or what labels were used, at the time of purchase?

The TRC team also asked owners which of these labels was the most important in influencing their home purchasing decision⁷⁶. Below, the TRC team presents responses, based on the number of owners that were aware of this label or description. Because the number of owners aware of some labels was very small, the TRC team presents the values and the percentages (if the percentage was based on at least five owners).

Owner group	Energy efficient	Solar home	CAHP home	ENERGY STAR Home	LEED Home	GPR home	Passive House
ZNE-type owners in interviews ⁷⁷)	10 of 29 (34%)	7 of 20 (35%)	0 of 4	1 of 16 (6%)	0 of 5 (0%)	1 of 4	2 of 3
Energy Efficient owners in surveys	54 of 93 (58%)	10 of 22 (45%)	2 of 8 (25%)	18 of 63 (29%)	1 of 12 (8%)	0 of 17 (0%)	Did not ask

Figure 35. Most Important Label or Description, in Influencing Owners' Purchasing Decision

⁷⁵ Not all owners in sample had homes that met this description.

⁷⁶ For custom owners, the TRC team asked which description or label was most important to their design decisions.

⁷⁷ This question was added after several interviews were completed, so not all interviewees provided a response.

6. DATA COLLECTION INSTRUMENTS

This section provides the data collection instruments in the following order:

- ◆ Request for Information from ZNE Practitioners: questions in the electronic survey
- ◆ Builder Interview Guide
- ◆ Program Manager Interview Guide
- ◆ Appraiser Interview Guide
- ◆ Lender Interview Guide
- ◆ Building Official Discussion Guide
- ◆ Planner Discussion Guide
- ◆ ZNE-type Owner Interview Guide
- ◆ ZNE-type Owner Forum Guide
- ◆ Energy Efficient Owner Survey Instrument
- ◆ Code-built Owner Forum Guide



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MEMORANDUM

February 26, 2014

To: Derek Jones (PG&E), Anna LaRue (Resource Refocus)
From: Marian Goebes, Abhijeet Pande (TRC), Ann Edminster (Design AVEnues)
Re: **Draft Request for Information from ZNE community members**

ZNE NETWORK REQUEST FOR INFORMATION (RFI)

Pacific Gas and Electric Company (PG&E) and the joint Investor Owned Utilities (IOUs) have contracted TRC to conduct a market characterization of residential zero net energy (ZNE) homes. The purpose of the project is to characterize the market, assess ZNE rating systems and financing opportunities, and assess drivers and barriers for market actors in achieving ZNE.

Introduction

The primary purpose of the ZNE Network Request for Information (RFI) is to identify market actors for interviews, identify ZNE and near ZNE projects, and gather case studies about these projects. We will also ask RFI recipients for their opinions on market size (estimates of the number of ZNE type homes in California). For most of the respondents that have been active with ZNE projects and are willing to participate in an interview, we will follow up this survey with an interview to collect more information. Consequently, this survey is very brief and does not touch on many of the study topics.

Our general approach will be to send an electronic survey (Survey Monkey) to members of the ZNE community.

Survey Script

Introduction and Respondent Background

On behalf of the Pacific Gas and Electric Company (PG&E) and the joint Investor Owned Utilities (IOUs) TRC is conducting a study to characterize the residential Zero Net Energy (ZNE) new construction market, and to assess the drivers and barriers to the adoption of ZNE, near ZNE, and ZNE-ready homes (referred to here as “ZNE-type homes”).

The purpose of this Request for Information (RFI) is to collect information about ZNE-type projects, estimate the market size of ZNE-type homes in California, and identify individuals to interview. Your responses will remain anonymous, and your name will only be used if you indicate you are willing to participate in an interview. Your confidentiality is important to us.

Thank you for your time!

What is your title or occupation?

What is your role as it relates to ZNE (or very low energy using) homes?

ZNE Terms

We have defined ZNE terms, for more consistency in responses, as follows:

- ZNE home: highly energy efficient with **sufficient** onsite renewable generation to annually offset consumption.
- Near ZNE home: highly energy efficient with **insufficient** onsite renewable generation to annually offset consumption
- ZNE ready home: highly energy efficient with **no** onsite renewable generation

In addition to these "ZNE-type homes", we provide the following term:

- Distributed Generation (DG)-only home: low energy efficiency (i.e. equivalent to, or slightly more efficient than, code) with onsite renewable generation, such as Photovoltaic (solar). (This home does not follow the California energy supply loading order.)

Would you categorize ZNE-type homes differently than how we did above? [Y/N/ Don't know] If so, how:

What does the term "highly energy efficient" mean to you? For example, is there a specific target such as x% better than code, or a list of features that define a "highly energy efficient" home?

What other ZNE terms have you heard in the market?

Your ZNE Home Involvement

Using the terms as we define them above, **Please identify the ZNE-type homes (e.g., ZNE, near ZNE, ZNE ready homes) that you have been involved with.**

For each project:

- **Please provide a project name or other descriptor, so that we can have an identifier for discussing the home, and to identify overlap between your response and others' responses.** [slots for up to 12]
- **How would you describe each project, using the terms as we described them:**
 - ZNE home: highly energy efficient with **sufficient** onsite renewable generation to annually offset consumption.
 - Near ZNE home: highly energy efficient with **insufficient** onsite renewable generation to annually offset consumption
 - ZNE ready home: highly energy efficient with **no** onsite renewable generation

- Other (Please specify below)
- **Please email case studies, websites, or other source documents.** (Megan Dawe MDawe@trcsolutions.com)

Your Estimates of Market Size

Approximately how many DG-only (e.g., solar PV-only) homes have you been involved with? (We define DG-only as low energy efficiency - i.e. equivalent to, or slightly more efficient than code; with onsite renewable generation.)

- 0
- 1-20
- 21-50
- 51-100
- 101-500
- 501-1000
- Over 1000

Using the terms previously described (and copied here for reference):

- ZNE home: highly energy efficient with sufficient onsite renewable generation to annually offset consumption.
- Near ZNE home: highly energy efficient with insufficient onsite renewable generation to annually offset consumption
- ZNE ready home: highly energy efficient with no onsite renewable generation

As a reminder, we are asking only about homes constructed as ZNE-type homes (not retrofits).

Please provide your best estimate of the total number of ZNE homes in California.

- 0
- 1-20
- 21-50
- 51-100
- 101-500
- 501-1000
- Over 1000

Please provide your best estimate of the total number of near ZNE homes in California.

- 0
- 1-20
- 21-50
- 51-100
- 101-500
- 501-1000
- Over 1000

Please provide your best estimate of the total number of ZNE-ready homes in California.

- 0

- 1-20
- 21-50
- 51-100
- 101-500
- 501-1000
- Over 1000

Recommended Referrals and Closing

For the ZNE-type projects you have been involved with, do you have case studies, websites, or other project documents you could share? (Y/N)

Would you be willing to participate in a phone interview so that we can gather more information about these projects and other aspects of this market? (Y/N)

Do you have suggestions of individuals we should contact for interview requests, particularly builders, financiers, appraisers, owners, or government officials? (Y/N)

If you have links to project case studies, or suggestions of people for interviews, please provide them below. Or skip this question and we will email you to request this information.

Please provide your name and email. Your survey responses are confidential. Your name will only be used if you indicated we could contact you for an interview, case studies, or contacts. (You may also enter "Prefer not to state".)

Do you have any other comments you'd like to make?

Thank you for your time!

To: Derek Jones (PG&E)

From: Marian Goebes (TRC), Abhijeet Pande (TRC), and Marjorie McRae (Research into Action)

Re: ZNE Builder interview guide

May 13, 2014

Instrument Information

Pacific Gas & Electric (PG&E) and the joint Investor Owned Utilities (IOUs) are conducting a Residential Zero Net Energy (ZNE) Market Characterization study. The purpose of the study is to characterize the ZNE market, assess the use of rating systems and financing opportunities for ZNE homes, and assess market actors' drivers for and barriers to the adoption of ZNE homes. TRC is the contractor leading the study. Research into Action, a subcontractor to TRC, is conducting the market actor interviews and developing the guides for these interviews.

One of the key market actors interviewed will be ZNE homebuilders. The TRC team will interview 10 to 20 builders, approximately 2/3 production and 1/3 custom builders; and representing builders active in northern and southern California, and across the state. (We will target true builders, not designers, architects, or energy consultants, because builders make the financial investment.) To identify high performance builders, TRC will work with our ZNE community contacts, and the California Advanced Home Program (CAHP) managers.

This interview will be conducted by telephone by Research into Action staff, and will take approximately 20-30 minutes. Due to logistical difficulties of scheduling, and concerns for interview bias, IOU staff will not be able to listen into these calls. However, the study report will provide key findings from the interviews. If requested, anonymized notes can be provided as well. This document presents the builder interview guide.

To keep the interview to the desired length, we will send the builder a brief survey after the call requesting quantitative information about the ZNE homes he or she has built. Where possible, we will pre-populate the survey for the builder and ask him/her to confirm these choices, to reduce the builder's time. This survey will include multiple choice or short answer questions on the following topics for each ZNE home:

- Energy efficiency and distributed generation measures present in the home:
 - Advanced envelopes
 - Reduced air infiltration
 - Reduced duct leakage
 - Ducts in conditioned space
 - Efficient HVAC and water heating equipment and efficient distribution strategies
 - Efficient lighting, appliances, controls and monitoring
 - On-site solar photovoltaic (PV)
 - Solar hot water systems
 - Other type of renewable energy (e.g., off-site PV, wind, or other – describe)
 - Electric vehicle charging stations

Residential ZNE Market Characterization Builder Interview Guide, p. 2

- Gray water systems
 - Innovative energy efficiency features not otherwise mentioned
- Location (city) of ZNE home
- Year the home was built
- Year it was first occupied

Instrument

Introduction

Hello, my name is _____ and I'm with Research Into Action calling on behalf of California utilities. We are talking to builders and developers to learn more about the California market for newly constructed homes built to be zero net energy, or "ZNE."

[IF CONTACT NAME KNOWN] Could I speak with [Name]?

[IF CONTACT NAME NOT KNOWN] I would like to speak with a senior person at your company who works on initiatives for highly efficient or ZNE homes, perhaps the owner, vice president or a principal. Who would that be?

[IF CONTACT NAME NOT KNOWN AND OWNER-DRIVEN CUSTOM] I would like to speak with the person at your company who is most familiar with ZNE or highly efficient homes **[OR NAME PROJECT IF KNOWN]**, perhaps the project manager or site superintendent. Who would that be?

Name and Title: [OPEN-ENDED RESPONSE]

Phone: [OPEN-ENDED RESPONSE]

[WHEN CONNECTED WITH THE CORRECT PERSON] Hello, my name is _____ and I'm with Research Into Action. We are talking to builders and developers to learn more about the California market for newly constructed homes built to be zero net energy, or "ZNE." as part of a study of ZNE homes for the California utilities. We are talking with you because you have been referred to us as a builder of high performance homes in California.

Screening and Basic Company Information

S1. The goal of this study is to help accelerate the adoption of ZNE building. Your participation will provide insights about ways the utilities and the California Public Utilities Commission can support demand through incentives, programs, education, financing, or other market-driving strategies. This interview should take about 20-30 minutes depending on your responses. We'll keep your responses anonymous. But I'd like to include your name and your company in the ZNE Report acknowledgments. Is this okay?

1. Yes
2. No
3. Maybe [If they want to get through the interview first]

[Do not read:]

98. Don't know
99. Refused

S2. Also, if you're interested, your company could submit candidate ZNE projects for consideration in the study's high performance home photo gallery. Do you have any ZNE or near ZNE projects you'd like us to consider including? [INTERVIEWER: Does builder want their ZNE project(s) included in the high performance home gallery?]

1. Yes [Ask for name of project]
2. No

S3. Is now a good time to talk?

[SINGLE RESPONSE]

1. Yes → Thank you. Would it be OK if I recorded our conversation to aid in my note taking?
2. No → Is there another person at your company involved in such activity? [IF NO, THANK AND TERMINATE]

[Do not read:]

99. Refused → [THANK AND TERMINATE]

[IF NEEDED] Appointment date and time:

[AS NEEDED TO GAIN PARTICIPATION] We would be happy to send you the study once published.

S4. In the past three years, what percentage of your California single-family homes would you say were designed and built to exceed the Title 24 building code?

1. [OPEN-ENDED RESPONSE]
2. 0% → Probe to verify that they did not build ENERGY STAR or other certified high efficiency homes [IF still 0% - THANK AND READ TERMINATION SCRIPT]

[Do not read:]

98. Don't know → [THANK AND TERMINATE]
99. Refused → [THANK AND TERMINATE]

[TERMINATION SCRIPT] We are looking for builders and developers with direct experience designing and building homes that exceed California new construction energy codes. Are you aware of any firms we might talk with that has such experience? [IF NOT, THANK AND TERMINATE]

S5. Of all the homes your company has built in the past three years, about how many are: [Interviewer see reference for definitions: <http://www.neahomes.com/custom-v-spec-v-tract-homes.html>]

1. Custom homes commissioned by a private homeowner (Specify number): [OPEN-ENDED RESPONSE]
2. Spec [speculative] homes (Specify number): [OPEN-ENDED RESPONSE]
3. Production or subdivision homes (Specify number): [OPEN-ENDED RESPONSE]
4. Something else (Please specify): [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know
99. Refused

ZNE Terminology and ZNE Home Characteristics

I'd like to ask you about the terms you use to describe these types of homes, and some of their unique characteristics.

Q1. I have been using the term ZNE. How do you describe these types of homes to potential buyers? *[If they provide more than one term, ask them to differentiate between these different categories.]*

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q2. And, what do you expect in terms of performance from a ZNE home?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q3. Do you have a target efficiency when building ZNE homes? If so, please describe. *[If needed – for example, to you have a target percent above code, energy use intensity, or a specific set of measures?]*

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q4. When building ZNE homes, do you have a typical size of renewable energy systems (such as a photovoltaic, or PV, system) that you install? If so, please describe.

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q5. Have you found that there is an extra cost to building a ZNE home compared to a home built to current codes?

1. Yes

2. No

[Do not read:]

98. Don't know

99. Refused

Q6. **[IF YES to Q55]** Compared to a new 2,500 square foot home build to current codes, what would you estimate is the incremental cost of building the same sized ZNE home?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q7. In your experience, are homebuyers willing to pay more for a ZNE home?

1. Yes

2. No

3. Depends / Some of them are

[Do not read:]

98. Don't know

99. Refused

Q8. **[IF YES TO Q7]** About how much more are prospective homebuyers willing to pay for a ZNE home?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q9. Would you say that ZNE-Type homes sell faster, slower, or in about the same amount of time as code-built homes?

1. Faster

2. Slower

3. About the same

[Do not read:]

98. Don't know

99. Refused

Q10. [In response to Q9] Why do you think this is?

Builder Motivations and Barriers

Q11. Why did your company decide to build ZNE homes? *[IF OWNER-DRIVEN CUSTOM: "Why was your company interested in building this ZNE home?"]*

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q12. Has your experience building these ZNE homes met these expectations? [*IF OWNER-DRIVEN CUSTOM*: “Has your experience building this ZNE home met those expectations?”]

1. Yes
2. No

[Do not read:]

98. Don't know
99. Refused

Q13. [**IF YES TO Q121**] In what ways?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know
99. Refused

Q14. Do you face challenges in permitting, designing, or constructing ZNE homes that are different from non-ZNE homes? [*IF OWNER-DRIVEN CUSTOM*: “Did you face challenges permitting, designing, or constructing this ZNE home that were different from non-ZNE homes?”] Note that we will discuss any challenges to selling and marketing ZNE homes in a different section.

1. Yes
2. No

[Do not read:]

98. Don't know
99. Refused

Q15. [**IF YES TO Q143**] If so, what [are / were] some of these challenges?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know
99. Refused

Homebuyer Motivations and Marketing

Now I'd like to ask you some questions about homebuyers motivations for buying ZNE homes, and how you market them.

Q16. In your opinion, what are homebuyers main motivations for buying ZNE homes [*IF OWNER-DRIVEN CUSTOM*: “What was your client’s main motivation for building a ZNE home?”]?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q17. **[SKIP IF ONLY OWNER-DRIVEN CUSTOM:]** What characteristics, if any, do ZNE homebuyers have in common? [If needed, we are interested in things like, they may fall into a similar income bracket, or they are environmentally conscious, or interested in new technology.]

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q18. **[SKIP IF ONLY OWNER-DRIVEN CUSTOM:]** What marketing messages or marketing strategies, if any, do you use for ZNE homes that are different from how you market non-ZNE homes?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q19. Do you market the energy performance of ZNE homes? If so, do you have any concerns about promising a specific performance?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q20. Do you have any other challenges with marketing ZNE homes?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q21. Are there barriers for homebuyers considering ZNE homes?

1. Yes

2. No

[Do not read:]

98. Don't know

99. Refused

Q22. **[IF YES to 08]** What are these barriers?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q23. **[IF YES to 08 AND IF NOT APPARENT FROM Q19]** In your opinion, which of these barriers is the most critical for homebuyers?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q24. **[IF YES to 08]** How, if at all, has your company tried to address these barriers?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q25. **[IF YES to 08]** Can you recommend any tools or resources that the utilities or others could provide to help you overcome these barriers?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Rating Systems, Branding, and Labeling

Now I'd like to ask about rating systems, branding, and labeling for ZNE homes.

Q26. Do you communicate the California HERS rating of the ZNE home to buyers? *[IF OWNER-DRIVEN CUSTOM: "Did you communicate the HERS rating of the ZNE home to the homeowner?"]* [HERS = Home Energy Rating System. Note that the California HERS is different from the national HERS rating, although similar in principle.]

1. Yes

2. No

[Do not read:]

98. Don't know

99. Refused

Q27. If so, what value do you think the HERS rating provides to homebuyers? *[IF OWNER-DRIVEN CUSTOM: "If so, what value do you think the HERS rating provides to the home owner?"]*

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know

99. Refused

Q28. [For your ZNE homes / For this ZNE home], in which, if any, of the following labels or programs have you participated?

[MULTIPLE RESPONSE]

1. California Advanced Home Program
2. LEED
3. Green Point Rated
4. ENERGY STAR
5. Passive house
6. Other, please specify: [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know
99. Refused

Q29. What rating, certification, or label do you think is most helpful in communicating the value of ZNE/energy-efficient homes?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know
99. Refused

ZNE Market Size and Future Motivations

We are close to the end of the interview. I'd like to ask about the number of ZNE homes you have built and the future of ZNE homes.

Q30. Approximately how many total new single family homes has your company built or been involved with in California in the past three years? Include projects completed or underway. Your best estimate is fine.

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know
99. Refused

Q31. And during that same time frame, about how many ZNE homes has your company built in California?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know
99. Refused

Q32. In the next five years, would you expect the rate at which your company builds ZNE homes to increase, decrease, or stay about the same?

1. Increase
2. Decrease

3. Stay about the same

[Do not read:]

98. Don't know
99. Refused

Q33. Over the next five years, do you expect homebuyer demand for ZNE homes in California to increase, decrease, or stay about the same?

1. Increase
2. Decrease
3. Stay about the same

[Do not read:]

98. Don't know
99. Refused

Q34. What factors do you think will lead to greater market demand for ZNE homes?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know
99. Refused

Q35. How do you think the type of ZNE homebuyer or their motivations might change in the next five years?

1. [OPEN-ENDED RESPONSE]

[Do not read:]

98. Don't know
99. Refused

Closing and Referrals

To close, I'd like to ask for possible referrals.

Q36. We are trying to interview lending organizations that provide construction financing loans to builders or developers of energy efficient or ZNE homes. Could you recommend any lending organizations and contacts at that organization?

1. [OPEN-ENDED RESPONSE]
2. No

[Do not read:]

98. Don't know
99. Refused

Q37. **[IF PRODUCTION BUILDER:]** We are also interviewing appraisers of energy efficient or ZNE homes. Could you recommend any such appraisers?

1. [OPEN-ENDED RESPONSE]
2. No

[Do not read:]

98. Don't know

99. Refused

Q38. Finally, we are trying to get feedback from ZNE homeowners or people who have contact with the owners. Do you have any contacts you would be willing to share, such as [FOR PRODUCTION BUILDERS: homeowner associations, or property managers, or a sales office at a ZNE-type community.] [FOR CUSTOM BUILDERS: owners that might be interest in a 20-25 minute phone interview.]

1. Yes [OPEN-ENDED RESPONSE]

2. No

[Do not read:]

98. Don't know

99. Refused

Q39. Those were all of my questions. Thank you for your time!

[IF HAVE SEPARATE MARKETING CONTACT]

Thank you so much for your time and for providing contact info for your marketing staff. I'll give your Marketing person a call to obtain his/her views.

[IF NO SEPARATE MARKETING CONTACT]

Thank you so much for your time and insights.

[INTERVIEWER NOTE] If requested [no need to offer], we will provide summary of our research -- mention that again here and make sure we have mailing info.



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MEMORANDUM

February 17, 2014

To: Derek Jones (PG&E)
From: Marian Goebes, Abhijeet Pande (TRC)
Re: **Program Manager Interview Guide for Res ZNE Market Characterization**

PROGRAM MANAGER INTERVIEW GUIDE

Pacific Gas & Electric (PG&E) and the joint Investor Owned Utilities (IOUs) have contracted TRC to conduct a market characterization of residential zero net energy (ZNE) homes. The purpose of the project is to characterize the market, assess ZNE rating systems and financing opportunities, and assess drivers and barriers for market actors in achieving ZNE.

As a preliminary data collection activity, TRC will interview managers of programs that incentivize energy efficient new construction. The purpose of these interviews is to gather the program managers' feedback on these issues, and ask the managers for their recommendations of market actors to interview. TRC plans to interview:

- ◆ The CAHP program managers at PG&E, SCE, SDG&E, and SoCalGas (4 total interviews)
- ◆ A PG&E staff member representing net energy metering or distributed generation programs (to be interviewed later)
- ◆ Build it Green program staff
- ◆ Program manager for the U.S. Department of Energy (DOE) Challenge Homes

This memo presents the final interview guide.

Interview Guide

Interview Introduction

On behalf of PG&E and the joint IOUs, TRC is conducting a residential ZNE market characterization study. The objectives are to characterize ZNE homes and the ZNE market, investigate ZNE financing opportunities, and assess market barriers and drivers for ZNE.

We are speaking with program managers both to gather their knowledge on these topics, and to ask for their recommendations of ZNE market actors for interviews. Thank you in advance for your time.

Background

Name (known) and Title

Please briefly describe how your role relates to residential ZNE.

Has your program tried to accelerate the adoption of ZNE and near ZNE (not just energy efficient) homes in the market you serve? If so, how?

Does your program coordinate with NSHP? If so, how? [example: referring program participants to NSHP]

Does your program coordinate with other CAHP programs, such as SCE CAHP?

ZNE Terms

What do you think ZNE should mean as it relates to your program's objectives and goals?

What role should the California HERS Design Rating (formerly known as HERS II) play in the ZNE definition?

Are you familiar with Time Dependent Valuation (TDV) and the state energy agencies' intent to use it as the metric for ZNE? How can the concept of TDV be communicated to the market, as it relates to the value of ZNE?

Market Size and Demographics

We'll be discussing the differences between new construction ZNE homes, near ZNE homes, "ZNE ready" homes, and Distributed Generation (DG)-only homes. For the purposes of this study, we define these as:

- ◆ ZNE home: high energy efficiency with sufficient onsite renewable generation to annually offset consumption.
- ◆ Near ZNE home: high energy efficiency with insufficient onsite renewable generation to annually offset consumption.
- ◆ ZNE ready home: high energy efficiency with no onsite renewable generation.
- ◆ DG-only home: low energy efficiency (i.e. equivalent to, or slightly more efficient than, code) with onsite renewable generation.

Let's start by discussing ZNE homes:

- ◆ What is the number of new construction ZNE homes in your program?
- ◆ How many builders participating in your program have experience with ZNE homes?
- ◆ Can you provide us with the locations (city, county or some other identifier) of each ZNE home?
- ◆ What is the ratio of custom to production?
- ◆ How many ZNE homes are you aware of that did NOT go through your program?
- ◆ What do you think will most affect the future adoption of ZNE over the next six years (i.e. to achieve the CPUC/CEC 2020 goal for residential ZNE new construction)?

Now let's discuss near ZNE homes:[same questions as above, for near ZNE]

Next, let's discuss ZNE ready homes: [same questions as above, for ZNE ready]

Finally, let's discuss DG-only homes: [same questions as above, for DG-only]¹

Builders' Expectations about ZNE homes

What other ZNE related terms, or terms for very low energy using homes, have you heard in your market? What do you think are builders expectations from ZNE homes?

What are builders' motivations for building ZNE and near ZNE homes? How do these motivations differ from building energy efficient (but not highly efficient) homes?

What are builders' barriers for building ZNE and near ZNE homes? How do these barriers differ from building energy efficient (but not highly efficient) homes?

What do you think could help builders overcome these barriers? (e.g., education or training – probe for what; different incentives; other)

Homeowners' Expectations about ZNE homes

What do you think are home buyers' expectations from ZNE homes?

What are owners' motivations for purchasing ZNE and near ZNE homes? How do these motivations differ from purchasing energy efficient (but not highly efficient) homes?

What are owners' barriers for purchasing ZNE and near ZNE homes? How do these barriers differ from purchasing energy efficient (but not highly efficient) homes?

What do you think could help home buyers overcome these barriers? (e.g., education or training – probe for what; tiered incentive structures; other)

Recommended Resources and Referrals

Do you have any case studies or other project information about ZNE or near ZNE homes from your program that you could share?

We would greatly appreciate if you could provide us with contact information for builders or developers of ZNE or near ZNE homes, that are active in your program area. How could we best achieve that?

We will be conducting a 15 minute phone survey of non-ZNE CAHP homeowners to understand their attitudes, awareness, motivations, and barriers towards ZNE, and compare it with those of ZNE (and near ZNE) homeowners. We are asking for your help in identifying the homeowners that we can target for these phone surveys. Please let us know who we should contact to begin the process of identifying customer contact information.

We would like to hold in-person focus groups with ZNE (or near ZNE) homeowners. We are looking for subdivisions or communities with high numbers of ZNE or near ZNE homes. Do you have any recommendations?

¹ This question set may only be relevant to the New Solar Homes Program (NSHP); however, it is important to distinguish DG-only homes from Near-ZNE homes align with the state's ZNE policy by following the loading order whereas the former do not.

MEMORANDUM (continued)

To: Derek Jones (PG&E)

Re: Res ZNE MC Program Staff interview guide

February 21, 2014

Study Recommendations and Closing

Those are all of my questions. Are there any particular questions that you would like us to investigate through this study?

Thank you for your time!

PG&E Zero Net Energy Residential New Construction Market Assessment Study-Appraisers Interview Instrument

Instrument Information

Pacific Gas & Electric (PG&E) and the joint Investor Owned Utilities (IOUs) are conducting a Residential Zero Net Energy (ZNE) Market Characterization study. The purpose of the study is to characterize the ZNE market, assess the use of rating systems and financing opportunities for ZNE homes, and assess market actors' drivers for and barriers to the adoption of ZNE homes. TRC is the contractor leading the study. Research into Action, a subcontractor to TRC, is conducting the market actor interviews and developing the guides for these interviews.

One of the key market actors interviewed will be appraisers who may have worked with a ZNE project or projects. The goal of this task is to determine the drivers, barriers, and opportunities for financing residential ZNE new construction, and explore their methodology for valuing energy efficient and ZNE homes. The known population of appraisers with experience valuing ZNE homes is small. We plan to interview six to eight appraisers with some experience valuing ZNE homes. TRC will identify these appraisers using our ZNE contacts, and by emailing attendees of courses for appraising green real estate, held by PG&E and Build it Green.

Instrument

Introduction and Scheduling

Hello, my name is _____ with Research Into Action. We've been contracted to conduct a market characterization of Zero Net Energy Homes for PG&E and the California utilities. Because the valuation process is a critical part of selling homes, we are speaking with appraisers with experience valuing these types of homes. We got your name....[explain as appropriate]. I am not selling anything.

I'd like to schedule about 20-25 minutes to ask you some questions about your experience as an appraiser of energy efficient homes. Your responses will provide important feedback to the utilities and state agencies in designing programs and other tools to increase the adoption of ZNE in California.

[If needed] If you have any questions or concerns please contact Marjorie McRae at 503-287-9136.

Do you have any questions before we get started?

[IF YES]: Thank you. Would it be OK with you if I recorded our conversation to aid in my note taking?

Background and Experience

1. We are interested in a special segment of the single family new construction market in California- highly energy efficient or zero net energy homes. Are you familiar with the term "zero net energy" (or ZNE)?
 - a. Yes
 - b. No
 - c. Don't know
2. What does the term ZNE mean to you? There are no right or wrong answers here. We want to know how the market interprets ZNE.
3. About how many home appraisals do you conduct each year? Your best estimate is fine.
4. How many of each, including none, of the following types of homes have you appraised?]:

- a. Highly energy efficient homes
- b. Homes with solar photovoltaic (i.e., solar panels)
- c. Homes with on-site energy generation other than solar panels? [micro hydro, small scale wind?] – please describe:

[If no to all items in Q4, terminate or ask for another viable contact]

Throughout the interview, I will be using the term “ZNE-type homes” to refer to homes that are highly energy efficient and/or that have on-site renewable energy, such as solar panels installed. Using this interpretation, a ZNE-type home may use natural gas, but this gas use could be offset using renewable energy.

5. How long have you been involved in appraising ZNE-type homes in California?
6. What about outside California?

Valuation Methodology

I'd now like to ask you questions regarding how you develop an appraisal for a ZNE-type home. We'll start by discussing energy efficiency, and then discuss homes with on-site generation, like solar panels.

7. In general, how do you account for any change in value when appraising a home that is energy efficient?

[Probe with the following subquestions as needed.]

- a. What documentation do you request?
 - b. Do you refer to any recognized guidelines in relation to specific features? (such insulation levels or efficiency of heating systems)?
 - c. Does the level of efficiency matter in terms of the home valuation? In other words, does the value change based on whether a home is more or less efficient?
 - d. Do you consult with other people (e.g., other appraisers, builders, or others) when developing an appraisal for these homes?
 - e. Do you utilize any calculators to calculate benefits, such as reduced utility bills? If so, which calculators? [If needed, for example, their own calculators, or a calculator on-line: if so, which one.]
8. How do you account for any change in value when appraising a home with solar panels or another type of on-site generation? [Note to interviewer: best practice is to calculate the value from solar separately from EE but many appraisers may not be aware of this]
 9. Are you familiar with a Home Energy Rating System (HERS) score?

- a. If so, do you use the Home Energy Rating System score to develop your value conclusion?
 - b. If so, how do you use the HERS score?
10. Do you use past energy bills (for existing homes), or another predictor of energy bills, to develop your value?
- a. If so, how? [If not, skip to next Q11.]
 - b. What sources do you use to obtain energy use data for comparables?
11. Based on your experience, do ZNE-type homes sell for more than homes with standard energy features?
- a. If so, what is the range of premium that you have observed (as a percent value) for this increase?
12. I'm going to list some possible features of ZNE-type homes. Please rate your assessment of each one as high, medium, low, or none in terms of the potential value added to a ZNE-type home's appraisal. You can also say that you don't know.
- a. Improved building envelope, such as higher levels of insulation or tighter air sealing?
 - b. High performance windows?
 - c. Higher efficiency equipment, such as more efficient heating, cooling, and water heating equipment?
 - d. Solar photovoltaic systems (i.e., solar panels)?
 - e. Low annual energy costs?
 - f. Water efficiency or reclaimed water systems, such as gray water systems?
 - g. Improved durability?
13. Are there any other features or selling points that you think add value to ZNE-type homes?
14. We want to understand how green home labels affect the appraised value of efficient homes. Let's start with LEED – have you ever appraised a home with LEED certification? Would you expect a LEED certification to affect the appraised value of a home? If yes, how? What about Greenpoint Rated homes.... [Interviewer: continue through list below]

STANDARD	AFFECTS VALUE (YES/NO)	EFFECT ON VALUE
LEED for Homes		
Greenpoint Rated		
An ENERGY STAR Home		
California Advanced Home		

STANDARD	AFFECTS VALUE (YES/NO)	EFFECT ON VALUE
Program participant		
Passive House		

- 15. In general, do you approach the appraisal of a home with a green label differently than one without a label? If so, how?
- 16. Does the presence of a label or other type of certification change your confidence in the performance of a given home?
- 17. If so, why is this?

Barriers

I'd like to find out more about the barriers that arise in your appraisal of ZNE-type homes.

- 18. Let's start with homes with energy efficiency features but no on-site generation. What are the most common challenges that emerge during the appraisal of energy efficiency features?
- 19. What about on-site energy generation? Are there specific challenges associated with valuing properties with on-site energy generation? [Probe: what specific challenges have you experienced?]
- 20. Do you include the depreciation of the energy efficiency or on-site generation feature of the home over time in your valuation?
- 21. What has been your experience in obtaining adequate data for comparables for homes that are energy efficient or have on-site generation?
- 22. What has been your experience with lenders when presenting your conclusions for a ZNE-type home? Have they tended to accept your value conclusions?
- 23. Have you found any successful strategies for overcoming any of the barriers you described?

Training

We are almost done. I'd like to close by asking about training opportunities and resources that might be helpful for appraisers.

- 24. Have you attended any trainings or become certified to develop valuations of energy efficient homes, or homes with solar panels or other on-site generation? [Note to interviewer – We are aware of the following, but there may be more: Build it Green's

Certified Green Real Estate Professional, and the Appraisal Institute's Green Designation.]

25. [if they answered "yes" to training question]
 - a. What organization provided the training?
 - b. Was the training helpful in valuing ZNE-type homes?
 - c. If so, which part of the training was particularly helpful?
 - d. What other type of training, would be helpful in valuing ZNE-type homes?
26. [if they answered "no" training question]
 - a. What type of training, do you think would be helpful for you to conduct appraisals of ZNE-type homes?
27. What types of tools or resources would be helpful for appraisers to value ZNE-type homes?
28. Do you have any recommendations for potential changes to appraisal requirements for ZNE-type homes?

Conclusion

My last question is about referrals.

29. We plan to interview financiers that have experience providing loans for ZNE-type homes. Can you recommend any banks, credit unions, or other organizations that you have worked with that provide loans for ZNE-type projects?
 - a. Can you provide a contact name at each organization?

Thank you very much for your time!



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MEMORANDUM

July 14, 2014

To: Derek Jones (PG&E) and collaborators at Investor Owned Utilities, California Public Utilities Commission, and California Energy Commission

From: Pat McGuckin (Cadmus), Marian Goebes (TRC), and Abhijeet Pande (TRC)

Re: **Final Lender Interview Guide for Zero Net Energy Market Characterization**

Introduction and Purpose

Pacific Gas & Electric (PG&E) and the joint Investor Owned Utilities (IOUs) are conducting a Residential Zero Net Energy (ZNE) Market Characterization study. The purpose of the study is to characterize the ZNE market, assess the use of rating systems and financing opportunities for ZNE homes, and assess market actors' drivers for and barriers to the adoption of ZNE homes.

An important data collection step will be interviews with staff at lending institutions that provide financing for home buyers of ZNE-type homes. The study scope focuses on single family new home construction. However, because there are few ZNE-type homes, we propose asking questions about financing for all single family home purchases that are energy efficient and/or include distributed generation (e.g., solar photovoltaic or fuel cell). Retrofits and multifamily buildings are not included in the study.

TRC is the contractor leading the study. Cadmus will conduct these interviews under separate contract with PG&E, because of Cadmus's existing relationships with lending institutions. The interviewees will be identified primarily through contacts provided by Cadmus. Cadmus plans to interview 6-8 financiers.

We provide the final interview guide below.

Interview Guide

Scheduling Call

The scheduling call and interview introduction will be conducted by Cadmus staff experienced in talking with lenders. To build rapport and elicit cooperation from busy executives, the conversations must be informal and seemingly unscripted. The scheduling call will follow this general outline:

- *Hi _____. My name is _____. I'm with a national energy consulting firm named Cadmus. I'm calling because name of IOU serving their location has asked us to interview lenders about how the utility could encourage mortgage lending for energy-efficient homes. Do you have a moment to see if you might be willing to schedule a short interview?*

If NO: don't push... stop. Consider asking if there is someone else we could interview.

- If our research indicates that they offer energy efficient mortgages or other special loans for energy efficient homes or improvements: *First, can I confirm that you offer type of loan?*

If our research does not indicate this: *First, can I ask if you offer energy efficient mortgages or other special loans for energy efficient homes or improvements?*

- *We're interested in your experience with lending to people who are buying new homes, especially energy efficient homes or homes with solar systems or other types of renewable energy. We'd like to hear your thoughts on 15 quick questions, like whether you think people who buy energy-efficient homes are better credit risks, or if you see any indication that appraisers are taking energy efficiency into account. Would you be willing to schedule 30 minutes later this week or next to talk with our senior clean energy finance consultant and give us your input?*
- Schedule time and send meeting invitation.

Interview Introduction

Financial Institution Name:

Respondent's Name and Title:

Phone:

Email:

Date:

Interviewer:

- *Is this still a good time for us to talk? [If NO: Reschedule.]*

- *We have 15 questions that will take roughly 30 minutes to answer. If we go a few minutes long would that be a problem, or do you have a hard deadline?*
- *You might also like to know that all of your answers will be kept completely anonymous. I don't expect that we'll be getting into anything sensitive, but that's our standard policy. Do you have any questions before we start?*

A. Zero Net Energy

1. *Are you familiar with the term Zero Net Energy (ZNE)?*
 - a. *If YES: What does it mean to you?*
 - b. *If NO: Explain – We define it as a home that is highly energy-efficient and produces all the energy it needs through solar power or similar renewable energy systems.*
2. *Have you made any loans for ZNE homes?*
 - a. *If YES: For new or existing homes?*

If EXISTING: For purchasing the home or making improvements?

Did you offer any special terms?

Do you target ZNE homes?
 - b. *If NO: What is the reason for not having made any loans for new ZNE homes?*

Would you know it if a loan is for a home with high efficiency or solar?

Would you care if a loan is for a home with high efficiency or solar?
3. *Do you see any specific benefits or concerns associated with lending for a new ZNE home?*

B. Energy-Efficient Mortgages

4. *Do you offer any sort of Energy-Efficient Mortgages? [If appropriate, explain - FHA, VA, Fannie Mae, and Freddie Mac offer special loan terms, such as an increase in the allowable debt-to-income ratio, for homes that meet specific efficiency-efficiency requirements.]*

[If we already know from our research and the scheduling call that the answer is Yes, skip the lead-in question and just ask what types of EEMs.]

If NO: *What is the reason for not offering Energy-Efficient Mortgages?*

What would it take for you to be willing to offer Energy-Efficient Mortgages?

Would a subsidy or incentive from the utility make a difference in your willingness to offer Energy-Efficient Mortgages?

If YES or MAYBE: How big a subsidy or incentive would it take?

[Skip to section C. Other Lenders.]

If YES: *What types of Energy-Efficient Mortgages do you offer?* [Prompt for categories below as appropriate.]

- a. *HUD FHA?*
- b. *VA?*
- c. *Conventional? (i.e., Fannie Mae or Freddie Mac)*
- d. *ENERGY STAR?*
- e. *Other [Describe]*

5. *Do you offer any special interest rate or other discount for Energy-Efficient Mortgages?*

If YES: What sort of discount?

What are the eligibility requirements, such as an ENERGY STAR rating?

6. *Do you offer Energy-Efficient Mortgages for both new homes and existing homes?*

7. *How many Energy-Efficient Mortgages did your institution originate in the last year?*

- a. *What percentage is that of your total number of mortgages?*
- b. *When did you start offering Energy-Efficient Mortgages?*
- c. *What is the trend in the number of Energy-Efficient Mortgages you are originating?*
- d. *What trend in Energy-Efficient Mortgage volume do you expect over the next five years?*
- e. *What do you think it would take to significantly increase the volume of Energy-Efficient Mortgages?*

8. *Why do you offer Energy-Efficient Mortgages?*

9. *Have you had any issues with offering Energy-Efficient Mortgages?*

10. *Are customers already aware of Energy-Efficient Mortgages or does someone else, such as the builder or real estate agent, usually have to tell them about Energy-Efficient Mortgages?*

If SOMEONE ELSE: [Probe for who tells them.]

a. *Would a loan officer suggest an Energy-Efficient Mortgage to a borrower?*

If YES: *Under what circumstances and when?* [Probe for whether they would suggest an EEM to all borrowers or just those who mention energy efficiency; and whether they would typically suggest an EEM before or after the borrower has identified a home to purchase.]

11. *Do you market Energy-Efficient Mortgages?*

If YES: [Ask these follow-up questions.]

a. *To whom do you market?* [Probe for: potential new customers, existing customers, builders, real estate agents, and anyone else.]

b. *How do you market to these people?* [Probe for: sales visits or phone calls (e.g., to builders and real estate agents), mailings, bill stuffers, flyers, in-branch signs, and anything else.]

c. *Do you think your efforts influence borrowers' to buy an energy-efficient home?*

If YES: *Why do you think so?*

Skip to section D. All Lenders...

C. Other Energy-Efficiency and Renewable Energy Loans

12. *Do you offer any sort of special energy-efficiency or renewable energy loans?*

[If we already know from our research and the scheduling call that the answer is Yes, skip the lead-in question and just ask what kind of loans.]

If YES: *What kind of loans?* [Prompt for categories below as appropriate]

a. *Energy efficiency?*

i. *Unsecured?*

ii. *Other?* (describe)

b. *Renewable Energy?*

i. *Unsecured?*

ii. *Other?* (describe)

If NO: **Skip to section D. All Lenders.**

13. *Do you offer any special interest rate or other discounts for these loans?*

If YES: *What sort of discount?*

What are the eligibility requirements, such as an ENERGY STAR rating?

14. *Why do you offer these loans for [energy efficiency / renewable energy]?*

15. *Have you had any problems or difficulties with offering these types of loans?*

16. *Do you market these loans?*

If YES: [Ask these follow-up questions.]

- a. *To whom do you market?* [Probe for: potential new customers, existing customers, contractors, real estate agents, and anyone else.]
- b. *How do you market to these people?* [Probe for: sales visits or phone calls (e.g., to contractors and real estate agents), mailings, bill stuffers, flyers, in-branch signs, and anything else.]
- c. *Do you think your efforts influence borrowers' to make energy improvements?*

If YES: *Why do you think so?*

D. All Lenders

17. *Do you think that borrowers who want energy efficient homes tend to be more conscientious and less likely to default than lenders in general?*

If YES: *What evidence do you have of this?*

18. *Do you see any evidence that appraisers are factoring in the value of energy efficiency or solar systems?*

19. *Have you encountered the situation where a seller had financed a solar system and the buyer wanted to assume that loan?*

If YES: *How did you handle the situation?*

20. *Have you encountered the situation where a seller does not own the solar system on their roof—for example when they lease the system—and the buyer wants to assume the lease?*

If YES: *How did you handle the situation?*

E. Conclusion

21. *Thank you, that was my last question. Is there anything else you would like to add, or any final questions you would like to ask me?*

MEMORANDUM (continued)

To: Derek Jones (PG&E) et al.

Re: Final Lender Interview Guide for ZNE Market Characterization

July 14, 2014

- a. *If I have a quick follow-up question, would it be okay for me to call or email you?*

Thank you very much for your time.



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MEMORANDUM

June 4, 2014

To: Derek Jones (PG&E) and counterparts at other Investor Owned Utilities (IOUs)

From: Marian Goebes, Abhijeet Pande, Stephanie Berkland (TRC)

Re: **Final Discussion Guide for Building Officials**

Introduction and Purpose

Pacific Gas & Electric (PG&E) and the joint Investor Owned Utilities (IOUs) are conducting a Residential Zero Net Energy (ZNE) Market Characterization study. The purpose of the study is to characterize the ZNE market, assess the use of rating systems and financing opportunities for ZNE homes, and assess market actors' drivers for and barriers to the adoption of ZNE homes. TRC is the contractor leading the study.

An important data collection step will be a one hour web-based discussion with building officials. We will include officials that have been active in ZNE adoption (e.g., officials who are actively engaged in renewable and energy efficiency), and those that have not. We will also include officials representing a range of geographic distributions. TRC will work with IOU contacts and a California Building Officials (CALBO) representative to identify officials for the building official discussions.

Below, we present our guides for this discussion. **Because this will be a group discussion, with multiple people answering each question, TRC must limit the total number of discussion questions to keep to the promised timeframe of one hour.**

Building Official Discussion Guide

Introduction and Scope

Thank you for joining us. We will be discussing what we are calling zero net energy (ZNE) or ZNE-type homes. This includes homes that are highly energy efficient, and which may have on-site renewable energy installed, such as solar photovoltaic (solar panels). We are focusing our scope on new construction of single-family residential buildings. For time concerns, we will not be discussing commercial buildings, multifamily, or retrofits. We are trying to understand the barriers and opportunities for highly energy efficient homes and onsite renewables from your perspective. We purposely tried to recruit building officials with a mix of ZNE experience, to represent the range of building officials in California. So if you have little ZNE experience, your perspective is still important.

This will be a confidential conversation. Please do not repeat the individual responses of others on the call. We would like to record this conversation for note-keeping reasons, but we will not share this recording outside this group, and we will destroy this recording after the study is completed. Is this okay?

The results of this discussion will allow the California utilities, state agencies, and others to provide support for building officials and others to accelerate the adoption of ZNE in residential new construction.

Pre-Discussion Information

Prior to the discussion, TRC will ask each participant to provide the following:

- ◆ Title, and Jurisdiction represented
- ◆ What do you typically see in terms of energy efficiency of the homes in your jurisdiction
- ◆ What do you typically see in terms of solar photovoltaic or other types of renewables
- ◆ Does your jurisdiction track the home's compliance margin (percent better than Title 24, part 6)?
- ◆ Approximately how many homes have you inspected that are highly energy efficient (which we'll define as being at least 30% more efficient than code), that have solar photovoltaic or other types of distributed generation (DG), or that are both energy efficient and have DG?
- ◆ Is there a trend in terms of how many homes are highly energy efficient.

Discussion Topics

- ◆ Successes and challenges
 - Are there any procedures that you do differently (or would have to do differently) when inspecting ZNE-type homes? Are there any differences for the energy efficiency features? Any differences for the renewable energy features compared to homes that don't have renewable features?
(Tie this directly to what they've seen. For those who don't have experience, perhaps ask "based on what [so and so] said about the types of projects s/he sees, would you anticipate any differences in your inspection process?)
 - Have you had specific challenges with inspecting these types of homes? If so, what?
[If needed, probe: Are there ever conflicts with safety codes and ZNE measures? We have heard anecdotal evidence about fire safety conflicts and solar PV.]
 - Are there aspects that make inspecting these homes easier? If so, what?

- Are there any overarching concerns about inspecting homes with increasing amounts of energy efficiency and renewables.

(Ask them if increased options for EE are creating problems, such as too many options, don't know what they are looking at, can't tell if something is supposed to be energy efficient, does it matter to them if it is supposed to save energy? I guess this gets down to a general perception of the value vs the hassle of ZNE construction techniques.)

◆ Training:

- Have you received any special training for inspecting ZNE-type homes?
 - If so, please describe.
 - What, if anything, was helpful about this training?
- Could you recommend additional training, or other tools, that might be helpful for you or other building officials for inspecting ZNE-type homes?

◆ Code compliance

- In your experience, which aspects of the current energy code (2008 Title 24, which went into effect in 2010), do builders have the most trouble meeting?
- In your opinion, what might help builders meet current code? [If needed: this could include specific types of training, checklists, or other resources.]

◆ The California Energy Efficiency Strategic Plan calls for all residential new construction to be ZNE by 2020. We'd like to discuss the opportunities and challenges this may present.

- What benefits might there be for building officials if all home are ZNE construction? For example, would some aspects of inspection become easier?
- What challenges might there be for building officials if all homes are ZNE?
- What training or resources do you think building officials may need to inspect ZNE homes?



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MEMORANDUM

June 13, 2014

To: Derek Jones (PG&E) and counterparts at other Investor Owned Utilities (IOUs)
From: Marian Goebes, Abhijeet Pande, Stephanie Berkland (TRC)
Re: **Final Discussion Guide for Planners**

Introduction and Purpose

Pacific Gas & Electric (PG&E) and the joint Investor Owned Utilities (IOUs) are conducting a Residential Zero Net Energy (ZNE) Market Characterization study. The purpose of the study is to characterize the ZNE market, assess the use of rating systems and financing opportunities for ZNE homes, and assess market actors' drivers for and barriers to the adoption of ZNE homes. TRC is the contractor leading the study.

As part of our data collection, TRC will conduct a group discussion with planners, to understand their jurisdiction's requirements (beyond state code) for energy efficiency and distributed generation (e.g., solar photovoltaic) in residential new construction, why those requirements were developed, how they address Climate Action Plan and California Environmental Quality Act (CEQA) goals, and challenges and successes with developing the requirements.

The TRC team worked with the IOUs to identify the appropriate planners for the discussion. The group will include planners in jurisdictions that have implemented Reach Codes (or other ordinances for energy efficiency or distributed generation), and those that have not. We will also include planners representing a range of geographic distributions.

Because these will be group discussions, with multiple people answering each question, TRC must limit the total number of discussion questions to keep to the promised timeframe of one hour.

Planner Discussion Guide

Introduction and Scope

Thank you for joining us. We will be discussing how energy efficiency of buildings and on-site renewable energy (e.g., solar panels) are/can be incorporated into the planning process to meet jurisdictions' goals, such as California Environmental Quality Act (CEQA) and climate action plan goals for reducing greenhouse gas (GHG) emissions. These could be through reach codes, ordinances or Planned Unit Development (PUD) Agreements that encourage energy efficiency or on-site renewable energy. Please keep in mind:

- ◆ We are focusing our scope on new construction of single-family residential buildings. For time concerns, we will not be discussing commercial buildings, multifamily, or retrofits.
- ◆ It is important for us to hear from planners representing jurisdictions that have adopted Reach Codes or other measures promoting energy efficiency and on-site renewable energy, AND/OR that attempted to adopt measures but ultimately did not. The challenges are as important to us as the successes.

This will be a confidential conversation. Please do not repeat the individual responses of others on the call. We would like to record this conversation for note-keeping reasons, but we will not share this recording outside this group, and we will destroy this recording after the study is completed. Is this okay?

The results of this discussion will help the California utilities, state agencies, and others to accelerate the adoption of energy efficiency and on-site renewable energy in residential new construction.

Discussion topics

- ◆ Does your jurisdiction have a Reach Code, zoning ordinance, Planned Unit Development (PUD) Agreements, or other requirements for energy efficiency or on-site renewable energy in residential new construction?
 - If so, what type?
 - If not, Is your jurisdiction currently pursuing any of these? If so, which type?
- ◆ Origins and drivers:
 - Why were these mechanisms developed? Were they developed as part of climate action plans, or meeting CEQA goals?
 - Who (what type of market actors) were proponents of the ordinance/reach code? PUD Agreements?
 - What role did you or others in the planning department have in the adoption of the ordinance / reach code, or in the development of PUD Agreements?
- ◆ Barriers and solutions:
 - What concerns were raised about the ordinance/ reach code / PUD Agreements?
 - If the jurisdiction did adopt an ordinance or reach code, or includes energy efficiency / on-site renewable energy requirements in PUDs, how were challenges overcome?
 - If the jurisdiction did not adopt an ordinance or reach code, or does not include energy efficiency / on-site renewable energy requirements in PUDs, what were the main reasons?
- ◆ Market Feedback:

- What has been the impact of the ordinance/reach code/PUD Agreements in your jurisdiction? Has it met its intended goals so far?
- ◆ Training and Resources:
 - Did you receive any training or support to implement the ordinance/ reach code / PUD Agreement? If so, please describe.
 - Have you provided any training to help meet it? If so, please describe how and to whom.
 - What additional training or resources do you think may be needed for planners or others to adopt an ordinance/reach code/PUD Agreements to encourage energy efficiency and on-site renewables in residential new construction?

Instrument Information

Purpose

Pacific Gas & Electric (PG&E) and the joint Investor Owned Utilities (IOUs) are conducting a Residential Zero Net Energy (ZNE) Market Characterization study. The purpose of the study is to characterize the ZNE market, assess the use of rating systems and financing opportunities for ZNE homes, and assess market actors' drivers for and barriers to the adoption of ZNE homes. TRC is the contractor leading the study. Research into Action, a subcontractor to TRC, is conducting the market actor interviews and developing the guides for these interviews.

One of the key market actors interviewed will be the homeowners who live in ZNE or near-ZNE homes. This is an estimated population of about 10 ZNE and likely more than 500 near-ZNE homeowners in California. We plan to interview 40 homeowners (8 ZNE and 32 near-ZNE). TRC will identify homeowners for interviews using the California Advanced Home Program (CAHP) databases and through our ZNE community contacts. These interviews will be conducted by telephone by Research into Action staff, and will take approximately 20 to 25 minutes. Due to logistical difficulties of scheduling, and concerns for interview bias, IOU staff will not be able to listen into these calls. However, the study report will provide key findings from the interviews. If requested, anonymized notes can be provided as well. This document presents the homeowner interview guide.

Programmer and Interviewer Information

Data Source: ZNE and Near-ZNE homeowners (mix of CAHP and Request for Information projects)

Instruction conventions in this document:

- › [PROGRAMMING] Programming instructions are in bracketed CAPS.
- › *[Interviewer notes]* Interviewer instructions are in *italics*.
- › **[Piped value]** Contact list database inputs are in **bold**.

For each multiple response question, create separate binary variables for each response option.

Instrument

Contact ID: _____

Date: _____

Introduction

Hello, my name is _____ and I'm with Research Into Action, calling on behalf of California utilities. The utilities are conducting a study about homes that are highly energy-efficient or have on-site renewable energy. According to our records, your home was built to use little energy. I'd like to ask you a few questions about your home and your reasons for choosing this home. Your feedback will help California promote the construction of efficient homes like yours.

I'm estimating this interview will take about 20 to 25 minutes. Is now a good time to talk? If not, could we schedule another time at your convenience?

[If needed:] Appointment date and time: _____

Before we proceed, please know that your responses will be completely anonymous. Also, would it be OK with you if I recorded our conversation to aid in my note taking?

[If permission given, record the interview.]

[PROGRAMER: DISPLAY ALL QUESTIONS, UNLESS OTHERWISE NOTED.]

Screening

S1. Just to confirm, were you involved in the decision to buy this home?

[SINGLE RESPONSE]

1. Yes
2. No → [Ask to talk to someone in the home that was]
99. REFUSED → [Thank and Terminate]

Drivers/ Reasons For Purchase

Research questions: Who are the key market actors in the ZNE process? What are the major drivers and barriers for each?

Q1. What home features or characteristics were critically important in your decision to buy this home? Response Text

Q2. *[If they gave multiple reasons in Q2] Were any of the home features you just mentioned more important than the other features? If so, what was the most important feature?*
Response Text

Q4. Was your home ...*[Read all]*

[SINGLE RESPONSE]

1. Custom built specifically for you [IF NEEDED: You may have been involved in the design of the home.]
2. Or was it already built when you bought it

[Do not read:]

98. Don't know
99. Refused

[NOTE: Somewhat Parallels Builder Interview Questions]

[IF Q3= 1, READ “Option 1”, IF Q3= 2, 98, or 99, READ “Option 2”]

Q5. **OPTION 1:** Please tell me whether the following features had a ‘high,’ ‘medium,’ or ‘low’ level of importance in your decision about how **to** design your home. Let me know if any were not a consideration at all. So, how important to you was designing a home ...
[READ LIST]

OPTION 2: Please tell me whether the following features had a ‘high,’ ‘medium,’ or ‘low’ level of importance in your decision about which house **to buy**. Let me know if any were not a consideration at all. So, how important to you was buying a home ... *[READ LIST]*

[RANDOMIZE A-I]

Items	0 Not a consideration at all	1 Low importance	2 Medium importance	3 High importance	97 NA	98 DK	99 RF
a)...with very low utility bills							
b)...with a solar photovoltaic system							
c)...that was highly energy efficient							
d)...that had good indoor air quality							
e)... that was comfortable							
f)...that had high tech features like the latest appliances or energy efficient technologies							
g)...that was the greenest home in the neighborhood							
h)... that had an energy efficiency label							

Q5a. Of the features that I just mentioned, which one would you say was the most important in your decision about [IF Q4= OPTION 1 say “how to design your home,” IF Q4=OPTION 2 say

“which house to buy”]? [IF NEEDED: remind respondents of the features in the table above.]

Response Text

[ASK Q6 IF Q3=CUSTOM BUILT]

Q6. How involved were you in deciding what energy efficiency features would be included in your home? Response Text

Awareness of ZNE and Messaging

Research questions: What messaging has been used to communicate the ZNE value proposition to the single-family residential new construction market? Which have been successful? What are the benefits and disadvantages of various strategies to build "ZNE messaging" (e.g. showcase projects like UC Davis West Village vs. a ZNE tier in the California Advanced Homes Program)?

Q7. Are you familiar with the term “Zero Net Energy”?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

[ASK IF Q7=YES]

Q8. What does Zero Net Energy mean to you? There are no right or wrong answers here, we are exploring how homeowners interpret this term. Response Text

[ASK IF Q7=YES (THOSE AWARE OF ZNE)]

Q9. Do you recall how you learned about Zero Net Energy homes? Response Text

[After the interview is over, check all that apply from the list of codes given below. Also, if responses given are lacking sufficient detail, make sure to obtain enough detail.]

[MULTIPLE RESPONSE]

1. A showcase home
2. Your utility company
3. A builder
4. An architect or designer
5. The Internet
6. Magazines or newspaper articles
7. TV or radio spots
8. Friend or family member
9. Realtor
96. Other
98. DON'T KNOW
99. REFUSED

Q10. ALREADY BUILT: When you were buying your home, please tell me whether your home was described to you in any of the following ways:

CUSTOM: Please tell me whether your home was described to you in any of the following ways:

[RANDOMIZE A-J] [Parallels Builder Questions]

Descriptions	1 Yes	2 No	98 DK	99 RF
a)...as a Zero Net Energy house				
b)...as a passive house				
c)...as an ENERGY STAR certified house				
d)...as LEED certified house				
e)...as GreenPoint rated house				
f)...as California Advanced Home Performance house				
g) ...as a solar house				
h)a highly energy efficient house				
i)... a house that would have zero energy bills				
j) ...a sustainable house				

Q11. Was the energy efficiency of your home described to you in any other way? Response Text

Q12. Q10b. Of the descriptions I just mentioned, which was the most [if already built]: influential to your home buying decision / [if built for them] important to your home design process?

Barriers

Research questions: Who are the key market actors in the ZNE process? What are the major drivers and barriers for each?

Q13. What issues, if any, did you have with getting a loan for your home, because it was a Zero Net Energy or ZNE-type home? [If necessary: “When I say ZNE-type I mean high energy performance home.”] Response Text

Q14. Did you have any concerns about your home, because it is a ZNE-type home?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

Q15. If so, what were they? **Response Text**

[ASK Q16 A-E ITEMS ONLY IF THEY HAVE NOT BEEN MENTIONED IN Q15]

Q16. When building [if built for them] / choosing [if already built] your home, please let me know if you were “not at all,” “somewhat” or “highly concerned” about each of the following, because of the home’s status as a ZNE or high energy performance home...
[Read options; do not read 97-99]

[RANDOMIZE A-F]

Concerns	1 - Not at all concerned	2 - Somewhat concerned	3 - Highly concerned	97 NA	98 DK	99 RF
a) Resale value						
b) That an energy efficient house would not be comfortable						
c) Initial cost						
d) Ability to manage any of the high tech features of your home such as monitoring or maintaining solar panels, appliances or other controls						
e) Providing sufficient ventilation						

[ASK IF CONCERNS MENTIONED IN Q15 OR Q16]

Q17. And who or what information addressed or reduced your concerns? **Response Text**

[PROBE: For market actors/info source: Builder, architect, lender, appraiser, real estate agent, any others. Also, if they say they were somewhat or highly concerned about the “Resale value” or that it would “not be comfortable” in Q16, ask “why?”]

PV, Regulations and kWh Valuation

Original Research Question: Can the nuance in the expected state regulatory definition for ZNE based on a Time Dependent Valuation (TDV) metric be communicated to the marketplace.
REVISED FOR HOMEOWNER SURVEY: Homeowner awareness of, and views on, the energy rating of the home (specifically a HERS Rating).

Q18. Did you receive an energy rating or score, or a description of your home’s expected energy performance? *[PROBE: If they received a rating of some type, ask “Do you recall if it was called a HERS rating? A HERS rating is a score predicting energy use, with 100 being a newly built home with standard energy performance, and 0 being a ZNE home that uses no more energy than it produces annually with on-site renewables such as solar.”]* **Response Text**

Q19. If so, what information was provided or described? **Response Text**

Q20. Was this information useful? **Response Text** If so, how? If not, why not?

- Q21. Did you receive any information or training on the energy efficiency features or PV system of your home? Response Text
- Q22. If so, was it helpful? Response Text
- Q23. What other information or training would you like to have received? Response Text

Satisfaction / Experience [ASK ALL]

- Q24. [OMITTED AFTER 4 RESPONDENTS]
- Q25. When you first moved in, what expectations did you have for living in a highly efficient home?
- Q26. Have those expectations been met so far? [IF NOT: Why not?] Response Text
- Q27. What have you liked the most about living in your home? Response Text
- Q28. What have you liked the least about living in your home? Response Text
- Q29. If a friend were to ask you about buying a ZNE home, what advice, if any, would you give them?

Demographics and House Characteristics

Research question: Who are the early adopters of ZNE and near ZNE?

Thanks for sharing all that information. We are almost done with the interview. I just have a few final questions about your home and members of your household.

- Q30. When was your home built?
1. *[Record year]*
 98. DON'T KNOW
 99. REFUSED
- Q31. How many bedrooms do you have in your home?
1. *[Record # of bedrooms]*
 98. DON'T KNOW
 99. REFUSED
- Q32. Including yourself, how many people currently live in your home year round?
1. *[Record Number]*
 98. DON'T KNOW
 99. REFUSED

Q33. If your home were for sale, do you think the energy features would cause it to sell for “more”, “less,” or “about the same” as a home in the same location and of the same size, but with typical energy performance?

1. More
2. Less
3. About the Same
98. DON'T KNOW

[IF Q33 = 1 or 2 (More or Less)]

Q34. In terms of a percentage, about how much [more / less]?

1. *[Record % value]*
98. DON'T KNOW
99. REFUSED

Q35. If you were to buy another home to live in, how much of a priority would you place on buying a high energy-performance home? Would you say:

1. No Priority
2. Low
3. Medium
4. High
98. DON'T KNOW

Q36. How much more would you be willing to spend up front on your next home for it to be high-energy performance, compared to a home of the same size and in the same location with typical energy performance?

1. Response Text *[Interviewer: Responses will vary – percentage would be preferable over a \$ amount. That is, if \$ amount is given, ask respondents to give you their answer in terms of a percentage. Also, record verbatim response e.g., “however much will be paid back by energy bills”]*

Q37. Did you use an Energy Efficient Mortgage (EEM) or other type of energy efficiency financing when you bought your home? [Note – If needed – an EEM is an additional loan amount that is added to your mortgage, based on the expected utility bill savings from buying an energy efficient home.]

1. Yes
2. No
98. DON'T KNOW
99. REFUSED

Q38. That was my last question. Thank you very much for your valuable time. Your responses will be kept anonymous, but we would like to list you in the acknowledgments of the report. Is this okay? Response Text

Q39. Also, the California Public Utilities Commission (CPUC) is interested in identifying owners of high performance homes, to possibly receive recognition for your leadership in driving demand for highly efficient homes. Could I provide them with your contact information? The CPUC will make the final decisions about which homes are recognized through this program.

Interview End

TRC PG&E Zero Net Energy: Homeowner Forum

Purpose

Pacific Gas & Electric (PG&E) and the joint Investor Owned Utilities (IOUs) are conducting a Residential Zero Net Energy (ZNE) Market Characterization study. The purpose of the study is to characterize the ZNE market, assess the use of rating systems and financing opportunities for ZNE homes, and assess market actors' drivers for and barriers to the adoption of ZNE homes. TRC is the contractor leading the study, along with several subcontractors, including Research into Action.

Instrument Information

Key Research Objectives:

- Who are the early adopters of ZNE and near-ZNE homes?
- How do the attributes of the home meet (and fall short of) their preferences? (motivations, barriers)
- What messages have they heard about the ZNE value proposition, and which of these messages have they found most influential?

Instrument

Introduction

I want to thank you for coming here today. My name is _____ and I work for Research Into Action. I am not a utility employee. We are an independent research firm that conducts market research and evaluations in support of energy efficiency programs all over the country. We have been hired to help the CA Investor Owned Utilities better understand the experience of purchasing and living in a high performance home, like yours.

I know how busy all of you are, so I really appreciate your willingness to come here and participate in this discussion.

What you say here today will NOT be presented in any way that could identify you or your home, so please feel free to speak freely. We will summarize our discussion to inform our larger study but there will be no names or personally identifiable information presented in that summary. We also ask that you treat what others share as confidential, and we will just use first names today, even though I realize many of you may know each other's full names.

Moderator/Participant Roles

The way this works is that you should feel like this is your group – that you will be the talkers and I will be the listener. Even if you are little tentative or shy, it is really important that you speak up, as we need to hear from ALL of you about your experiences purchasing and living in your high performance homes.

While I need for you to speak one at a time, so I can hear each of you, I want to encourage you to interact and respond to comments made by others in the group. My job is to make sure that we explore some key topics and that everyone gets a chance to speak.

- the group has time to talk. I understand that everyone might not have something to add for every question.

1.1.1. Taping Procedures

We will be tape recording the discussion here today. The recording is just so I can have an accurate record of what you say and I won't have to take so many notes, and will be destroyed when the project finishes. Because of this, it is also important that you speak one at a time, so when I listen to the tape I can follow the discussion.

Group Introductions

To start, I'd like to go around the group and have each person say your first name, when you moved into your house, and something fun to do in the area, or something you enjoy about the area- just as an icebreaker.

Q1. Your name

Q2. When you moved into your house

Q3. [Ice breaker question] Something fun to do in the area or something you enjoy about the area

Awareness and Messaging

First, I'd like to talk about how you came to live where you live.

- Q4. How did you first hear about the [COMMUNITY NAME] homes and what did you hear about them?
- What was most appealing to you about these homes?
- Q5. I'd like to hear what some of the selling points and the language you have heard that is used to describe these homes and the lifestyle they offer. I'm going to write them down here [white board or easel] as you say them. [Probe for terms like: highly energy-efficient, high performance, zero carbon, carbon neutral, zero bill, HERS zero, ZNE- TDV. Probe for selling points like comfort, air quality, self-sufficiency, location, schools, etc.] [Brainstorm on board]
- Anything else?
 - Which of these things was the most important?
 - Which of these messages was appealing to you? Not appealing?
 - How about **labels**- such as ENERGY STAR, ZNE, or California Advanced Homes? Did you hear about any?
 - Did you question the credibility of any of these labels or descriptions?
- Q6. When you were looking at homes to buy, **how did you prioritize features** such as home location, amenities, price and energy performance? amenities, or price, and considering the energy performance to be a bonus?
- Before you heard about the [COMMUNITY NAME] homes, what had you heard about the availability of high performance homes?
 - **Where did you hear this** – such as read an article, saw an ad, heard about them from friends?
 - Did you consider other types of homes? Which features did you compare?
 - What sources of information did you consult to learn more, if any?
- Q7. For your home, **how did the builder -or anyone else- compare its energy use** to other homes? [Probe: X% above code, HERS II report, label, rating]
- How meaningful was this to you?
 - [As relevant:] What did you learn from the [report, label, rating]?

- Were these helpful? Could the information be improved in any way to be more helpful or more easily understood?

Home Purchasing and Experience

Q8. Now I'd like to talk about the actual purchasing process. What were the first steps of the you took in purchasing your high performance home?

- **Who did you work with** during your purchase process? What was their role? How knowledgeable were they about these homes?
- What was your experience having the home **appraised**? Did the fact that your home is ZNE have any impact on the appraisal or loan process? Were the people involved knowledgeable about its energy performance?
- How **did your experience buying this home differ** from other homes you have purchased, if at all? Easier, harder, or about the same? Why?
- Is there any information you did not receive at the time of purchase which would have been useful?

Q9. Now that you've been in your home for a while, **what things do you most appreciate about your home?**

- **Anything relating to your home's construction that you are dissatisfied with?**
- Anything relating to your experience living in your home that you are dissatisfied with?

Satisfaction and Lessons Learned

Q10. What were your expectations for what it would be like to live in your high performance home. **How has the experience compared to your expectations?**

- How satisfied are you with your **PV system and its output or level of electricity generation?**
 - a. **Do you know how much output you get?** (avg est: 2.4 kw, 3530 kWh/home)
- Are your utility bills in line with your expectations?
- How has the experience of living in your current home differed from living other places? What type of previous living arrangement did you have?

- Does your home include an energy feedback system (such as an in home display) or any other way for you to know about your homes' energy performance? How has this system worked for you?
- Do you charge an **electric vehicle** at your home? How is that working?

As we finish up, I have just a few more general questions.

Q11. Overall, how satisfied have you been with your high performance home?

- If you were to buy another home, how much of a priority would you put on it being energy efficient?
- Would you recommend a similar home to a friend or family member? Why? Why not?

Q12. To wrap up, I'd like to ask you what advice you might offer for someone similar to you who is considering purchasing a high performance home. What information would you pass on to someone else who might be interested in a high performance home? What do you wish you had known when you made the decision to buy your current home?

Thank you very much for your time.

ZNE Market Study: Energy Efficient Owner Survey

Instrument Information

Purpose

Pacific Gas & Electric (PG&E) and the joint Investor Owned Utilities (IOUs) are conducting a Residential Zero Net Energy (ZNE) Market Characterization study. The study characterizes the ZNE market, assesses the use of rating systems and financing opportunities for ZNE homes, and assesses market actors' (builders, appraisers, lenders, policy makers) and owners' drivers for and barriers to the adoption of ZNE homes. TRC is the contractor leading the study. Research into Action, a subcontractor to TRC, is conducting the market actor and homeowner interviews and developing the guides for these interviews.

One of the groups interviewed in this study will be owners of energy efficient but non-ZNE homes; some of these homes will have solar photovoltaic (PV)¹. These owners will be classified as "Energy Efficient owners" for this study, and will be identified using the IOU California Advanced Home Program (CAHP) databases by selecting homes that are 15-20% more efficient than the 2008 Title 24 standards. (In contrast, when developing the "ZNE owner" sample, the study identified homes that are at least 40% more efficient than 2008 Title 24 standards.) These Energy Efficient owners represent one potential group of next adopters of ZNE, and the study will compare their responses with those from ZNE owners to understand any differences in their purchasing perspectives. To facilitate this comparison, many of the questions in the survey below are similar to questions in the ZNE owner interview guide. While the ZNE owner interviews were more open-ended, the questions in this Energy Efficient owner survey are primarily closed-ended, with response options based on answers from the ZNE owner interviews.

The interviews will be conducted by telephone by CIC Research staff, and will take approximately 15 minutes. CIC Research staff will interview a minimum of 80 and up to 136 Energy Efficient owners, with the surveys split roughly in half between northern and southern CA owners. This document presents the Energy Efficient homeowner survey guide.

Table 1 lists research objectives and the associated survey questions.

¹ In some cases, we will know prior to the call if they have solar PV, because the CAHP program databases track recipients of New Solar Homes Partnership (NSHP) incentives and CAHP PV kickers. In other cases, the owner may have added solar PV later. We ask questions to cover each scenario.

Table 1: Research Objectives and Associated Questions

RESEARCH OBJECTIVES	RESEARCH QUESTIONS	ASSOCIATED QUESTIONS
Characterize residential ZNE new construction market and assess barriers	<ul style="list-style-type: none"> Who are the key market actors in the ZNE process? What are the major drivers and barriers for each (e.g., What influenced the owners' decision to make this home purchase? What concerns they had? Were they looking for a home with a PV?) 	Q1-Q12, Q20, Q26-Q31
	<ul style="list-style-type: none"> What types of customers are buying efficient but non-ZNE homes? [Results will be compared to the early adopters of ZNE and near ZNE.] 	Q32-Q34
Assess drivers, barriers, and opportunities for ZNE messaging	<ul style="list-style-type: none"> What messaging has been used to communicate the ZNE value proposition to the single-family residential new construction market? Which have been successful? What are the benefits and disadvantages of various strategies to build "ZNE messaging" (e.g., showcase projects like UC Davis West Village vs. a ZNE tier in the California Advanced Homes Program)? 	Q13-Q19
Investigate how to explain to consumers the ZNE metrics based on TDV	<ul style="list-style-type: none"> What are homeowner awareness of, and views on, the energy rating of the home (specifically a HERS Rating)? 	Q21-Q25

Programmer and Interviewer Information

Programming note style conventions in this document:

- › [PROGRAMMING] Programming instructions are in bracketed CAPS.
- › [Interviewer notes] Interviewer instructions are in *italics*.
- › [Piped value] Contact list database and prior response inputs are in **bold**.

Instrument

Introduction

Hello, my name is _____ and I'm with CIC Research, calling on behalf of California utilities. This is not a sales call. The utilities are conducting a study of energy-efficient homes to better understand how they can support builders and consumers desiring energy-efficient homes. According to our records, your home was built to be more energy-efficient than a typical home. I'd like to ask you a few questions about your home and why you chose to buy your home. Your feedback will help California utilities promote the construction of efficient homes like yours.

I'm estimating this interview will take no more than 15 minutes. Is now a good time to talk? If not, could we schedule another time at your convenience?

[If needed:] Appointment date and time: _____

Before we proceed, please know that your responses will be completely anonymous.

Screening

[Do not read question options/choices, unless explicitly stated to read them.]

[ASK ALL]

S1. Do you or members of your household own your home or do you rent it?

1. Own
2. Rent → [Thank and Terminate]
99. REFUSED → [Thank and Terminate]

[ASK ALL]

S2. Just to confirm, were you involved in the decision to buy this home?

[SINGLE RESPONSE]

1. Yes
2. No → [Ask to talk to someone in the home that was]
99. REFUSED → [Thank and Terminate]

[ASK ALL]

S3. Are you the first occupant/owner of your home?

[SINGLE RESPONSE]

1. Yes
2. No

- 98. DON'T KNOW
- 99. REFUSED

[ASK ALL]

S4. Is this your first home that you bought?

[SINGLE RESPONSE]

- 1. Yes
- 2. No
- 98. DON'T KNOW
- 99. REFUSED

Drivers/ Reasons for Purchase

Research Question: Who are the key market actors in the ZNE process? What are the major drivers and barriers for each?

[ASK ALL]

Q1. What home features or characteristics were critically important in your decision to buy this home? [*Do not read*]

[MULTIPLERESPONSE]

- 1. Size of the home (# of bedrooms, square footage, a very large room)
- 2. Lot size
- 3. Wanted low utility bills
- 4. Because it is a newly constructed home
- 5. Wanted energy-efficient features
- 6. Price of the home
- 7. Location of the home (near good schools, near work, in good neighborhood)
- 8. Because it had solar or PV panels
- 96. Other, please specify: _____
- 98. DON'T KNOW
- 99. REFUSED

[ASK IF Q1 ≠ DON'T KNOW OR REFUSED]

Q2. Of the features you just mentioned, what was the most important feature?

[SINGLE RESPONSE]

- 1. Size of the home (# of bedrooms, square footage, a very large room)
- 2. Lot size
- 3. Wanted low utility bills
- 4. Because it is a newly constructed home
- 5. Wanted energy-efficient features
- 6. Price of the home

- 7. Location of the home (near good schools, near work, in good neighborhood)
- 8. Because it had solar or PV panels
- 9. **[INPUT RESPONSE FROM Q1 “Other, please specify”]**
- 10. There was no single feature that was the most important/ it was the whole package
- 96. Other, please specify: _____
- 98. DON'T KNOW
- 99. REFUSED

[ASK ALL]

Q3. Were you aware at the time of purchase that your home was built to be more energy-efficient than a typical home?

[SINGLE RESPONSE]

- 1. Yes
- 2. No
- 98. DON'T KNOW
- 99. REFUSED

[ASK ALL]

[ASK IF S3=YES (FIRST OWNER OF THEIR HOME)]

Q4. Was your home ...*[Read all]*

[SINGLE RESPONSE]

- 1. Custom built specifically for you *[IF NEEDED: You may have been involved in the design of the home.]*
- 2. A new construction home where you chose from a suite of house models and/or options *[IF NEEDED: Options could include additional features]*
- 3. A new construction home built for you where options/additional features were not available
- 4. Or was your home already built when you bought it

[Do not read:]

98. DON'T KNOW

99. REFUSED

[ASK IF Q4= 1 (CUSTOM BUILT) OR 2 (NEW HOME SEMI- CUSTOMIZED)]

Q5. When your home was built for you, did you have a choice to select natural gas in your home for these appliances? *[If no on any item, find out if the appliance installed was electric or natural gas]*

[RANDOMIZE A-D]

	1 Yes	2 No – electric appliance installed	3 No – natural gas appliance installed	98 DK	99 RF
a) Water heater					

b) Stove					
c) Furnace or heating equipment					
d) Clothes dryer					
e) Anything else [Please, describe: _____]					

[ASK IF Q5= YES ON ANY A-E ITEM]

Q6. And did you choose natural gas for any of those appliances?

[MULTIPLE RESPONSE, INPUT APPLIANCES WHERE THEY SAID “YES” IN Q5]

1. Water heater
2. Stove
3. Furnace or heating equipment
4. Clothes Dryer
5. [INPUT “Anything else” RESPONSE FROM Q5 HERE]
6. No – have not chosen natural gas for any of these appliances
98. DON'T KNOW
99. REFUSED

[ASK IF Q5 ≠ YES ON EACH A-E ITEMS]

Q7. Why didn't you choose to install any gas appliances in your home?

[MULTIPLE RESPONSE]

1. Natural gas option was more expensive/ didn't want to spend the money
2. Didn't care about fuel options for appliances
96. Other, please specify: _____
98. DON'T KNOW
99. REFUSED

[ASK ALL]

Q8. Is your home equipped with its own solar or PV system that generates electricity?

[SINGLE RESPONSE]

1. Yes
2. No
98. DON'T KNOW
99. REFUSED

[ASK IF Q8=YES]

Q9. Did the solar or PV system come with the house or did you install it later, after you purchased your home?

[SINGLE RESPONSE]

1. Came with the house
2. Installed later, after purchasing the home
98. DON'T KNOW
99. REFUSED

[ASK IF Q8=NO OR DON'T KNOW OR Q9=INSTALLED LATER]

Q10. At the time you were looking to buy a home, did you consider purchasing a home with solar PV panels?

[SINGLE RESPONSE]

1. Yes
2. No [SKIP TO Q12]
98. DON'T KNOW
99. REFUSED

[ASK IF Q10= YES]

Q11. And at that time, which of the following solar PV options were offered with the homes you considered purchasing? *[Read All]*

[MULTIPLE RESPONSE]

1. Leasing a PV system,
2. Owning a PV system, or
3. Having a Power Purchase Agreement *[IF NEEDED: A Power Purchase Agreement is where you purchase the electricity the PV system generates from the company that owns the solar system. This is not a type of lease- you would pay per kWh or energy used. With a lease, you would pay per month for renting the solar system on your roof.]*

[Do not read]

97. Something else *[Interviewer: if they say something else, please record their response here:]*_____
98. DON'T KNOW
99. REFUSED

[ASK IF Q10 = YES OR NO]

Q12. [IF Q10 = YES, ASK:] What was the primary reason you decided NOT to purchase a home with solar PV panels?

[IF Q10 = NO, ASK:] Why didn't you consider a home with a solar PV system?

[OPEN-ENDED RESPONSE, *But, categorize responses according to the options below after the interview is over; Do Not Read Responses below*]

1. Could not afford to purchase system
2. Didn't want to be responsible for maintenance
3. Worried about what would happen at resale
4. Thought estimated savings were too good to be true
5. Worried about hidden costs of owning a system
6. Didn't understand how a lease or PPA would work
7. Thought "no money down" was too good to be true
8. Worried about how panels would look on the house
9. Concerns about the contract length, end of contract, or buy-out options
10. Worried the company might go out of business
11. Something else [*Interviewer, please record their response*]:_____
98. DON'T KNOW
99. REFUSED

Awareness of ZNE and Messaging

Research Question: What messaging has been used to communicate the ZNE value proposition to the single-family residential new construction market? Which have been successful? What are the benefits and disadvantages of various strategies to build "ZNE messaging" (e.g., showcase projects like UC Davis West Village vs. a ZNE tier in the California Advanced Homes Program)?

[ASK ALL]

Q13. Are you familiar with the term "Zero Net Energy"?

[SINGLE RESPONSE]

1. Yes
2. No
98. DON'T KNOW
99. REFUSED

[ASK IF Q13=YES]

Q14. What does Zero Net Energy mean to you? There are no right or wrong answers here, we are exploring how owners interpret this term. [*Do not read, but categorize responses according to the options below.*]

[MULTIPLE RESPONSE]

1. Paying no utility bills/zero energy bills
2. Low utility bills/low energy cost per month
3. Over the whole year, the energy cost averages to zero
4. Home does not use more energy than it can produce/generate

- 5. Sustainable/self-sufficient home that does not need outside power
- 6. Other, please specify: _____
- 98. DON'T KNOW
- 99. REFUSED

[Interviewer: We want to know if people are thinking of all energy sources or just electricity when they are explaining what zero net energy means to them. So for options 1-5, please specify if respondent said “energy”, “electricity”, “electricity and gas” or something else:]

[ASK IF Q13=NO OR DON'T KNOW]

Q15. Zero net energy means that a home generates as much energy as it consumes in a year. The “zero net” refers to the notion that the amount of energy generated at home, minus the amount of energy consumed, is approximately zero. Have you heard of these homes?

[SINGLE RESPONSE]

- 1. Yes
- 2. No
- 98. DON'T KNOW
- 99. REFUSED

[ASK IF Q13=YES OR Q15=YES (THOSE AWARE OF ZNE)]

Q16. Do you recall how you learned about Zero Net Energy homes? *[Do not read]*

[MULTIPLE RESPONSE]

- 1. A builder
- 2. An architect or designer
- 3. The Internet
- 4. A showcase home
- 5. Your utility company
- 6. Magazines or newspaper articles
- 7. TV or radio spots
- 8. Realtor
- 96. Other, please specify: _____
- 98. DON'T KNOW
- 99. REFUSED

[ASK ALL]

Q17. Please tell me whether energy efficiency of your home was described to you in any of the following ways:

[RANDOMIZE A-J]

	1 Yes	2 No	98 DK	99 RF
--	-------	------	-------	-------

b)...as an ENERGY STAR certified home				
c)...as LEED certified home				
d)...as GreenPoint rated house				
e)...as California Advanced Home Performance house				
g) [ASK ONLY IF Q9=1]...as a solar home				
h) ...an energy efficient house				
j) ...a sustainable house				

[ASK ALL]

Q18. Was the energy efficiency of your home described to you in any other way? [*Probe to obtain details if they just say “yes” – that is, ask “how was the home described?”*]

1. Yes - Please describe: OPEN-ENDED RESPONSE

[Do not read:]

- 96. No: Energy efficiency of the home **was not** described to me in any other way
- 98. DON'T KNOW
- 99. REFUSED

[ASK IF MORE THAN ONE OF THE OPTIONS IN Q17=YES]

Q19. Of the descriptions I just mentioned, which was the most [IF Q4= 2, 3, 4, 98 OR 99 OR S3= 2, 98 OR 99 INPUT "influential to your home buying decision"; IF Q4=1 (CUSTOM BUILT) INPUT "important to your home design process"]?

[SINGLE RESPONSE]

- 1. An ENERGY STAR certification
- 2. LEED certification
- 3. GreenPoint rating
- 4. That it was a California Advanced Home Performance house
- 5. That it was a solar house
- 6. That it was an energy efficient house
- 7. That it was a sustainable house
- 96. Other, please specify: _____
- 98. DON'T KNOW
- 99. REFUSED

Barriers

Research Question: Who are the key market actors in the ZNE process? What are the major drivers and barriers for each?

[ASK ALL]

Q20. [IF Q4=1 (CUSTOM BUILT) INPUT "When building"; IF Q4= 2, 3, 4, 98 OR 99 OR S3= 2, 98 OR 99 INPUT "When choosing"] your home, please let me know if you were “not at all,” “somewhat” or “highly concerned” about each of the following, because of the energy-efficient features of your home... [Read options; do not read 97-99]

[RANDOMIZE A-F]

Concerns	1 - Not at all concerned	2 - Somewhat concerned	3 - Highly concerned	97 NA	98 DK	99 RF
a) Resale value						
b) That an energy efficient house would not be comfortable						
c) Initial cost						
d) Ability to manage the high tech features of your home (if any) such as monitoring or maintaining solar panels, appliances or other controls						
e) Providing sufficient ventilation						
f) Anything else (please, specify:)_____						

Regulations and kWh Valuation

What are homeowner awareness of, and views on, the energy rating of the home (specifically a HERS Rating) [Supports study goal to answer: Can the nuance in the expected state regulatory definition for ZNE based on a Time Dependent Valuation (TDV) metric be communicated to the marketplace?]

[ASK ALL]

Q21. Did you receive an energy rating or score, or a description of your home’s expected energy performance?

[SINGLE RESPONSE]

1. Yes
2. No
98. DON'T KNOW
99. REFUSED

[ASK IF Q21=YES]

Q22. Do you recall what you received? [IF NEEDED: For example, what was the name of the rating system?]

[MULTIPLE RESPONSE]

1. HERS rating
2. GreenPoint rated home
3. LEED certification
4. Something else [Interviewer, please record their response]:_____

- 98. DON'T KNOW/ DO NOT RECALL
- 99. REFUSED

[ASK IF Q21=YES]

Q23. Did you request this information or did you receive it when the home was first marketed to you?

[SINGLE RESPONSE]

- 1. Received during the initial marketing of the home
- 2. Requested
- 3. Something else [*Interviewer, please record their response*]:_____
- 98. DON'T KNOW/ DO NOT RECALL
- 99. REFUSED

[ASK IF Q21=YES]

Q24. How useful was the information you received? Please rate on a scale from 1 to 5, where 1 is "not at all useful" and 5 is "extremely useful."

[SINGLE RESPONSE]

- 1. 1- not at all useful
- 2. 2
- 3. 3
- 4. 4
- 5. 5- extremely useful
- 98. DON'T KNOW
- 99. REFUSED

[ASK IF Q24=1, 2, 3, OR 4]

Q25. Why do you say that? [*Probe to obtain details on how owners used the information they received (if at all). For example, was it part of the decision-making process to buy the home, and if so, how?*]

- 1. [OPEN-ENDED RESPONSE]

[Do not read:]

- 98. DON'T KNOW
- 99. REFUSED

Satisfaction / Experience

We are getting close to the end of the interview. I have a few questions about your satisfaction with your home and future purchasing decisions.

[ASK Q26 AND Q27 IF Q3=YES (AWARE THAT THEIR HOME WAS BUILT TO BE MORE ENERGY-EFFICIENT THAN A TYPICAL HOME)]

Q26. When you first moved in, what expectations did you have for living in an energy-efficient home? [*Do not read.*]

[MULTIPLE RESPONSE]

1. That it would be comfortable
2. Simple to maintain
3. To have lower energy bills
4. To have good ventilation
5. That everything would work because it is new
6. No expectations
96. Other, please specify: _____
98. DON'T KNOW
99. REFUSED

[ASK IF Q26≠ NO EXPECTATIONS, DON'T KNOW OR REFUSED]

Q27. Would you say that your expectations have been met, somewhat met, or have not been met so far?

[SINGLE RESPONSE]

1. Have been met
2. Somewhat met
3. Have not been met
98. DON'T KNOW
99. REFUSED

[ASK ALL]

Q28. If your home were for sale, do you think the energy features would cause it to sell for “more”, “less,” or “about the same” as a home in about the same location and of the same size, but with typical energy performance?

1. More
2. Less
3. About the Same
98. DON'T KNOW
99. REFUSED

[IF Q28= 1 or 2 (More or Less)]

Q29. In terms of a percentage, about how much [more / less]?

1. [*Record % value*]
98. DON'T KNOW
99. REFUSED

[ASK ALL]

Q30. If you were to buy another home to live in, how much of a priority would you place on buying a high energy-performance home like a zero net energy home, assuming it is in the right location? Would you say:

[SINGLE RESPONSE]

1. No Priority
2. Low
3. Medium
4. High
98. DON'T KNOW
99. REFUSED

[ASK ALL]

Q31. In terms of a percentage, how much more would you be willing to spend up front on your next home for it to be zero net energy or high-energy performance, compared to a home of the same size and in the same location with typical energy performance?

[SINGLE RESPONSE]

1. 0% - not willing to pay more
2. 1-5%
3. 6-10%
4. 11-15%
5. 16-20%
6. 21-30%
7. More than 30%
98. DON'T KNOW
99. REFUSED

Demographics and House Characteristics

Research Question: Who are those buying efficient but non-ZNE homes? [Supports study's goal to answer: Who are the early adopters of ZNE and near ZNE?]

Thanks for sharing all that information. We are almost done with the interview. I just have a few final questions about your home and members of your household that will enable us to compare your answers with those of others.

[ASK ALL]

Q32. How many bedrooms do you have in your home?

1. *[Record # of bedrooms]*
98. DON'T KNOW
99. REFUSED

[ASK ALL]

Q33. Including yourself, how many people currently live in your home year round?

- 1. [Record Number]
- 98. DON'T KNOW
- 99. REFUSED

[ASK ALL]

Q34. Including yourself, what are the ages of the people currently living in your home year round?

- 1. [Record Numbers]
- 98. DON'T KNOW
- 99. REFUSED

[ASK ALL]

Q35. That is all of the questions I have for you today. But, it is possible that we might be conducting a follow-up survey or an in-depth interview. Would you be willing to participate in such a survey or an interview down the road?

[SINGLE RESPONSE]

- 1. Yes
- 2. No
- 98. DON'T KNOW
- 99. REFUSED

Survey End

Thank you very much for all of your valuable time. We appreciate it.

TRC PG&E Zero Net Energy: Code-built Homeowner Forum

Purpose

Pacific Gas & Electric (PG&E) and the joint Investor Owned Utilities (IOUs) are conducting a Residential Zero Net Energy (ZNE) Market Characterization study. The purpose of the study is to characterize the ZNE market, assess the use of rating systems and financing opportunities for ZNE homes, and assess market actors' drivers for and barriers to the adoption of ZNE homes. TRC is the contractor leading the study, along with several subcontractors.

As part of our research, the TRC team will conduct an in-person forum with 8-12 owners of code-built homes in a California community to understand what energy efficiency or solar Photovoltaic (PV) options they were offered, which they considered, which they chose, and their motivations and barriers.

Results from this forum will be compared with results from previous activities in this study that gathered homeowner feedback, including a ZNE forum, ZNE phone interviews, and Energy Efficient owner phone surveys.

Instrument Information

Overview of Data Collection Activity:

Who: 8-12 Code-built owners. The Forum will be led by Research into Action, a subcontractor on the TRC team that has extensive experience conducting forums and focus groups.

What: In-person forum with owners of Code-built homes. The Forum will target owners of homes that considered energy efficiency and/or solar photovoltaic (PV), but that purchased homes with none or only one of these features.

Where: A development in the Sacramento area, that includes homes with a range of energy efficiency and solar PV options.

When: August 21, 2014, 6:30 pm

Duration: Two hours

Recruitment Strategy: TRC worked with the Homeowners Association (HOA) to send an email to the HOA group. The email described the forum and its purpose, offered homeowners \$100 for participation in the forum, and asked respondents to complete a short survey to understand what features they considered and ultimately purchased.

Key Research Objectives:

- Who are the people who choose not to purchase a ZNE or near-ZNE home?
- How do the attributes of their home meet (and fall short of) their preferences? (motivations, barriers)
- What messages have they heard about the ZNE value proposition and why did they not find the messaging compelling?
- What energy efficiency and solar PV options were they offered and why did they decide not to pursue them?

Instrument

Introduction

I want to thank you for coming here today. My name is _____ and I work for Research Into Action. I am not a utility employee. We are an independent research firm that conducts market research and evaluations in support of energy efficiency programs all over the country. We have been hired to help the CA Investor Owned Utilities better understand the experience of purchasing and living in a high performance home, likes yours.

I know how busy all of you are, so I really appreciate your willingness to come here and participate in this discussion.

What you say here today will NOT be presented in any way that could identify you or your home, so please feel free to speak freely. We will summarize our discussion to inform our larger study but there will be no names or personally identifiable information presented in that summary. We also ask that you treat what others share as confidential, and we will just use first names today, even though I realize many of you may know each other's full names.

Moderator/Participant Roles

The way this works is that you should feel like this is your group – that you will be the talkers and I will be the listener. Even if you are little tentative or shy, it is really important that you speak up, as we need to hear from ALL of you about your experiences purchasing and living in your homes.

While I need for you to speak one at a time, so I can hear each of you, I want to encourage you to interact and respond to comments made by others in the group. My job is to make sure that we explore some key topics and that everyone gets a chance to speak.

Also, we chose this group, because it represents a diversity of perspectives in terms of what energy features you considered when looking at a home, and which features you ultimately purchased. Everyone's experience is important, and we are not trying to elevate one perspective or choice over another.

1.1.1. Taping Procedures

We will be tape recording the discussion here today. The recording is just so I can have an accurate record of what you say and I won't have to take so many notes. The recording will be destroyed when the project finishes. Because of this, it is also important that you speak one at a time, so when I listen to the tape I can follow the discussion.

Group Introductions

To start, I'd like to go around the group and have each person say your first name, when you moved into your house, and something fun to do in the area, or something you enjoy about the area- just as an icebreaker.

- Q1. Your name
- Q2. When you moved into your house
- Q3. [Ice breaker question] Something fun to do in the area or something you enjoy about the area

Awareness and Messaging

First, I'd like to talk a little about how you heard about the [COMMUNITY NAME] homes and what got you interested in purchasing one.

- Q4. How did you first hear about the [COMMUNITY NAME] homes and what did you hear about them?
 - Did you purchase a new home from a set floorplan, or did you purchase an existing home? What was most appealing to you about these homes?
 - What energy efficiency and solar photovoltaic (PV) options were you offered when you were considering purchasing a home? (PROBE: If respondents only mention electric energy efficiency options, ask if any gas efficiency options were offered.)
 - If you were purchasing a new home from a set floorplan- which features were you offered that you declined? (PROBE: If respondents only mention electric features, ask if any gas features were offered.)
 - Did you choose any energy efficiency features? For those of you that did choose efficiency features, which did you choose and why? For those of you that didn't, why not? (IF NECESSARY: Clarify whether features they are talking about are gas or electric.)
 - [If not mentioned, ask about gas] What about any gas efficiency features? (Appliances such as gas furnace, NG storage water heaters, NG tankless water heaters)
 - Did you choose any solar PV options? Why or why not? [Note that TRC is choosing participants so that they should not have chosen solar PV, but we will leave this question open-ended to be safe.]

- Q5. I'd like to hear what some of the selling points and the language you have heard that is used to describe these homes and the lifestyle they offer. I'm going to write them down here [white board or easel] as you say them. [Probe for terms like: highly energy-efficient, high performance, zero carbon, carbon neutral, zero bill, HERS zero, ZNE-TDV. Probe for selling points like comfort, air quality, self-sufficiency, location, schools, etc.] [Brainstorm on board]
- Anything else?
 - Which of these things was the most important?
 - Which of these messages was appealing to you? Not appealing?
 - How about labels- such as ENERGY STAR Homes or California Advanced Homes? Did you hear about any?
 - Did you question the credibility of any of these labels or descriptions?
- Q6. Have you heard of the term ZNE (do not read: Zero Net Energy)?
- If so, what does the term mean to you? (IF NOT MENTIONED: Clarify whether respondents are thinking of electricity only or gas and electricity when describing this term?)
 - Definition: ZNE describes a building where the total amount of energy used by the building on an annual basis is roughly equal to the amount of renewable energy created on the site.
 - [If not mentioned, ask about gas] What about any gas efficiency features? (Appliances such as gas furnace, NG storage water heaters, NG tankless water heaters)
 - Is this appealing to you?
 - What would you worry about if you had the option to purchase a ZNE home?
 - How would you view a new government requirement that your only option when purchasing a new home would be a ZNE home with a PV system?

Satisfaction and Lessons Learned

- Q7. Now that you've been in your home for a while, what things do you most appreciate about your home?
- Q8. How about comfort- is your home as comfortable to live in as you hoped? [Probe: air flow, air quality, drafts, summer and winter temperatures]
- Q9. Are your utility bills in line with your expectations?
- Q10. Those of you who have a PV system, has the performance of your PV system met your expectations?

As we finish up, I have just a few more general questions.

- Q11. If you were to buy another home to live in, how much of a priority would you place on buying a high energy-performance home like a zero net energy home, assuming it is in the right location?
- Q12. To wrap up, I'd like to ask you what advice you might offer for someone similar to you who is considering purchasing a home. What do you wish you had known when you made the decision to buy your current home?
- Those of you with solar, anything you would tell someone considering solar?

Thank you very much for your time.